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NUCLEAR SCIENCE ABSTRACTS

Volume I Number 10

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KEY TO ABBREVIATIONS

BMIC	Bureau of Mines Information Circular
BNL	Brookhaven National Laboratory
BSC	Bureau of Standards Circular
CCCC	Carbide and Carbon Chemicals Corporation
CIT-DP	Carnegie Institute of Technology Department of Physics
DA	Douglas Aircraft
MIT-NSES	Massachusetts Institute of Technology Nuclear Science and Engineering Seminars
MIT-RL	Massachusetts Institute of Technology Radiation Laboratory
MIT-RLE	Massachusetts Institute of Technology Research Laboratory of Electronics
NACA	National Advisory Committee for Aeronautics
NDRC	National Defense Research Committee
NRC-WMC	National Research Council War Metallurgy Committee
NRL	Naval Research Laboratory
ORNL	Oak Ridge National Laboratory
PSC-SMI	Pennsylvania State College School of Mineral Industries
UI-EESR	University of Illinois Engineering Experiment Station Report

ABSORPTION AND SCATTERING OF RADIATION

1517 Analytical Method of Determining Transmission of Particles and Radiation Through Great Thicknesses of Matter, by A. R. Bobrowsky. National Advisory Committee for Aeronautics Technical Note No. 1712, September 1948. 35 p. (NACA-TN-1712)

A matrix method for determining transmission, scattering, and absorption of radiation, such as gamma rays and neutrons, in large thicknesses of matter is presented. The method can be used to determine the relative efficiency of a number of composite shields intended for use with one or more types of radiation. The procedure is also useful in designing such shields. Experimental data as yet unavailable are required for complete utilization of the method. Material radioactivity whose intensity may be considered to be independent of time is also treated. 5 references.

1518 Effect of Source and Shadow Shield Geometry on the Scattering of Gamma Rays, by M. S. Plesset, C. Hastings, and S. T. Cohen. Douglas Aircraft Company Project RAND Report RAD-236, February 26, 1948. 62 p.

The geometrical effects of the size of shadow shield and source on the intensity of gamma rays scattered into a receiver are illustrated by an exact calculation for two extreme cases. In the first case, the source is of negligible extent compared with the radius of the circular shadow shield. In the second case, the source is a sphere of the same radius as the circular shadow shield. Where intermediate cases are encountered, the extreme cases will suffice to estimate the effects of source-shield geometry. The present report is a continuation of RAD-196 "Scattering of Gamma Rays and Neutrons" by M. S. Plesset.

1519 The Shielding of Nuclear Reactors, by M. L. Goldberger. MIT Nuclear Science and Engineering Seminars XL and XLI, March 18 and 20, 1947. 15 p. (NP-159).

The problems of shielding are discussed from a theoretical standpoint with special considerations as to the penetration of shields, reflection of radiations around screens and streaming through shield openings, and induced activity in samples, equipment, etc. The biological effects of γ-rays, β-rays, and neutrons in the energy range 3-4 Mev and below are also considered, particularly in regard to tolerance dosages.

1520 Angular Distribution of the γ-Quanta Produced by the Annihilation of Positrons, by N. A. Vlasov and E. A. Tsirelson. Doklady Akademii Nauk SSSR 59, p. 879-882, February 11, 1948. (In Russian)

The curve of angular distribution of gamma rays produced by the annihilation of positrons was obtained in an experiment which permitted closer measurements than those made by Beringer and Montgomery (Physical Review 61, p. 222, 1942). The counters used had a 0.2 mm thick layer of lead on the inner surface of the aluminum cylinder. Two rectilinear groups of 5 counters each, connected in parallel, determined by the method of coincidences, the direction of the two gamma rays. The sensitivity of the instrument permitted the use of small sources and relatively large distances between source and counters. The direct results of the measurements show that at least 95% of the coupled gamma rays of annihilation are emitted with angles of 180° (with less than one degree deviation) between them. This indicates that a corresponding fraction of the positrons are annihilated with energies not exceeding 80 ev.

1521 The Efficiency of Radiation Shields, by A. E. De Barr. Review of Scientific Instruments 19, p. 569-573, September 1948.

The effect of a number of thick radiation shields of infinite thermal conductivity and of a type realizable in practice is analyzed by matrix algebra, and a method for calculating the temperatures of the various shields is also given. For identical thin shields it is found that the ratio of the power P_N

ABSORPTION AND SCATTERING OF RADIATION (Continued)

required to maintain a radiating surface of emissivity ϵ_0 at a given temperature with N shields to the power P required to maintain the same temperature without shields is given by

$$P_N/P = \left[1 + \epsilon_0 (f + f^2 + f^3 \ldots f^N) \left(\frac{1}{\epsilon_K} + \frac{1}{\epsilon_1} - 1\right)\right]^{-1}$$

where ϵ_K, ϵ_1 are the emissivities of the two sides of a shield and f is the fraction of the radiation leaving the inside of the nth shield which is incident upon the n-1th shield.

1522 Extension of De Barr's Analysis of Radiation Shielding, by J. B. Garrison and A. W. Lawson. Review of Scientific Instruments 19, p. 574-577, September 1948.

De Barr's (Review of Scientific Instruments 19, p. 569-573, 1948) formula for the efficiency of n thick radiation shields, with infinite thermal conductivity and diffuse surfaces, surrounding a black body source has been extended to the general case when the original source has an arbitrary emissivity. A simple procedure for calculating explicitly the temperature of any shield is given, and simple numerical examples are cited. The efficiency of shields which reflect partially diffusely and partially specularly is also discussed.

1523 Large-Angle Scattering of Na^{24} Gamma-Radiation, by Ernest Pollard and David E. Alburger. Physical Review 74, p. 926-932, October 15, 1948.

Scattering of the 1.38-Mev and 2.76-Mev gamma radiation of Na^{24} has been observed as a mean angle of 135°. A diagram of the experimental apparatus is shown. Mg, Al, Pb, and Hg scatterers were used, and three definite components of scattered radiation were observed. Absorption curves for these scatterers are shown. The softest component, of energy about 200 Kev, is Compton-scattered radiation; the next hardest, of energy 500 Kev, is the positron annihilation radiation. The third component has an energy between 1.1 and 2.8 Mev and is due, in part, to "bremsstrahlung," but seems to be somewhat too hard to be wholly explained by this process. It is not sharply resonant nuclear scattering since it appears nearly equally in Mg and Al, while only Mg should be sharply resonant. From the lack of sharp resonance with the Mg^{24} level at either 1.38 Mev or 2.76 Mev, it is concluded that these levels must be less than 1/100 ev wide and that the corresponding transitions are of quadrupole or higher order.

1524 On the Scattering of Fast Particles of Spin 1 by Atom Nuclei, by K. C. Kar. Indian Journal of Physics 22, p. 249-252, June 1948.

The wave statistical theory of scattering of fast particles by atomic nuclei due to spin-spin interaction, which was discussed for particles of spin 1/2 in a previous paper (Indian Journal of Physics 30, p. 69, 1947), is extended for particles of spin 1. In the previous paper the well known Mott formula was derived (Proceedings of the Royal Society 124, p. 425, 1929). In the case of electron-electron scattering, the expression obtained differs from that of Möller (Annalen der Physik 14, p. 531, 1932) in the general case, while at the limiting cases for which the velocity is too low or too high, the two formulas agree. The expression the author obtains for the total intensity of scattering is the same as a previously derived formula of Massey and Corben (Proceedings of the Cambridge Philosophical Society 35, p. 463, 1939), which was arrived at in a different way.

ATOMIC POWER

1525 Nuclear Reactors for Power Generation, by Ward F. Davidson. Electrical Engineering 67, p. 962-966, October 1948.

The various technical and engineering problems which arise in the process of transferring the energy of the fission reaction into heat in the steam or gas to be used in the heat engine are discussed. This includes a discussion of (1) conditions essential to the operation of a well-controlled reactor, (2) nuclear power plant design, and (3) economic considerations and efficiency of operation.

AVIATION

1526 Ceramic Coatings and Ceramic Bodies for Aircraft Power Systems, by Dwight G. Bennett. University of Illinois (Department of Ceramic Engineering) Engineering Experiment Station Report No. 26, Sec. 1-5 (Air Materiel Command Contract), July 30, 1948. 85 p. (NP-399)

This annual summary report presents the work done upon ceramic coatings and ceramic bodies for aircraft power systems during the twelve month period ending June 30, 1948. It consists of the following sections: Temperature resistant ceramic base coats for metal. The formulation and development of refractory ceramic base coats; the study of the effect of ceramic coatings on the strength of metals at elevated temperatures. Thermal insulation and radiation suppresive coatings. Thermal insulatory and protective characteristics of ceramic coatings; formulation, development, and testing of top coats and top coat bonding glasses. Special coatings for metals. High temperature ceramic paints; determination of radiant energy emissivity coefficients; the applications of coatings by means of a flame spray gun. Fundamental research on ceramic bodies. Hot tensile and modulus of rupture tests of ceramic bodies; a fusion study of the tertiary system of beryllia, silicon carbide, and zirconium phosphate, and the investigation of metal alloy additions to beryllia.

1527 Rockets and Other Thermal Jets Using Nuclear Energy with a General Discussion on the Use of Porous Pile Materials, by Hsue-Shen Tsien. MIT Nuclear Science and Engineering Seminars LIV and LV, May 13, and 15, 1947. 25 p. (NP-156)

Problems are pointed out in connection with the utilization of nuclear energy in rockets. The article discusses simple and relativistic theories of space rockets, idealized optimum rocket design using nuclear energy, specific examples of possible nuclear energy rockets, possibilities of reducing critical size, application of nuclear fuel to other thermal jets, and advantages of using porous pile material.

BIOLOGICAL EFFECTS OF RADIATION

1528 Hematological Studies on Patients Treated by Total Body Exposure to X-Rays; a Report of Studies up to June 30, 1946, by B. V. A. Low-Beer and R. S. Stone. AECD-2348 (CH-3863), February 1948, decl. October 22, 1948. 89 p. For publication in NNES.

Hematological studies were made on 29 patients who were treated by exposing their whole bodies to x-rays generated by 100, 200, or 1000 kv. Twenty-six of them were observed for sufficiently long periods of time to be of use in this study. Significant changes in the number of blood cells were observed in all of the patients and some of these changes appear to be relatively constant. The most consistent change was a decrease in the absolute number of lymphocytes following treatment, irrespective of the size of the dose and the physical factors of treatment. This decrease was followed by a return to normal in the post-treatment period. A decrease in the number of nuclear lobes per 100 neutrophils was a consistent finding in 9 patients for whom the lobation index was studied. The number of monocytes varied greatly as a result of exposure to radiation, but always returned to normal. The most frequent change was a large increase in numbers during the course of treatment. After the conclusion of treatment, frequently near the 30th and 60th days, significant deviations in the total white blood cell count and in the counts of the separate types of leukocytes were observed in almost all of the patients. In the late post-treatment period similar significant changes were frequent. These were observed at intervals varying often between 150 and 300 days, and in some patients as late as 680 days. The erythrocyte counts and the concentration of the hemoglobin occasionally showed a decrease during the course of the treatment, followed by a recovery to pre-irradiation levels in the early post-treatment period. In the late post-treatment period a temporary macrocytic hyperchromic anemia was observed in many of the patients. No changes in prothrombin concentration, sedimentation rate, icteric index or platelet count of any of the patients was observed.

BIOLOGICAL EFFECTS OF RADIATION (Continued)

1529 Inheritance of Mutational Changes Induced by Radiation in Paramecium Aurelia, by R. F. Kimball. Oak Ridge National Laboratory Report ORNL-175, October 1, 1948. 27 p.

A study has been carried out in Paramecium aurelia of the inheritance of effects of beta and x-radiation which first expressed themselves as reductions in vigor of some of the exautogamous progeny of irradiated animals. The technique used in investigating the inheritance was to cross the irradiated animals to unirradiated ones by conjugation. In some cases, the products of the cross were crossed to unirradiated animals. The genotypes of the products of the crosses were tested by sending their descendants through autogamy to bring about complete homozygosis. The clones from both members of the conjugant pairs were in the majority of the cases of normal vigor. The exautogamous progeny from both members of the pairs often included a high proportion of clones of reduced vigor indicating that the effect was transmitted to both members as would be expected if nuclear mutations were involved. There was clear evidence that the two members of a pair produced exautogamous generations which were more alike, on the average, than were those from different pairs from the same irradiated animal. This finding is in agreement with the fact that the two members of a conjugant pair should be of identical genotype as a result of conjugation.

It was possible to calculate the average number of mutations per micronucleus in the irradiated animals and in the animals resulting from the cross of irradiated to unirradiated. The average number in the former was approximately twice that in the latter as would be expected if gene mutations were involved. In one experiment an anomalous type of inheritance was found for which no adequate explanation can be offered. Viable homozygous clones of lowered fission rate have been obtained by autogamy in the descendants of irradiated animals. The lowered fission rate can be shown to be transmitted through both members of conjugant pairs between the low fission rate clones and normal animals. A noticeable feature of such viable but low fission rate clones is the great intraclonal variability in respect to fission rate and even viability itself. The conclusion was drawn that non-genic changes were not a major contributing factor to be reduced vigor resulting from radiation. It was also concluded that the results of the crosses have confirmed the assumption that reduced vigor in the exautogamous progeny of irradiated animals is an expression of micronuclear mutations induced by the radiation.

1530 The Effect of Roentgen Irradiation on Antibody Formation in Rabbits, by Charles G. Craddock, Jr. and John S. Lawrence. Journal of Immunology 60, p. 241-254, October 1948.

The new importance placed on the role of lymphoid tissue and circulating lymphocytes in antibody production, and the well-known detrimental effects of x-rays on lymphoid tissue morphologically led to this study in which the attempt is made to correlate the influence of roentgen irradiation on antibody production with that on lymphoid tissue. Rabbits were exposed to 250 r whole-body irradiations and given pre- or post-irradiation injections of antigen. Antibody production was markedly decreased when injections were made following irradiation. This is of a transient nature and the animals regained their ability to respond normally to antigen injection 40 days after exposure to x-ray. Irradiation, however, after the onset of antibody production does not impair ability to produce circulatory antibodies. The reason for this remarkable difference is not apparent, but it is suggested that reserve sources of tissue must be capable of carrying out antibody formation once it has begun even though the major portion of lymphoid tissue has been damaged. 34 references.

1531 The Gastroscopic Picture in Post-Irradiation Gastritis, by Eddy D. Palmer. American Journal of Roentgenology and Radium Therapy 60, p. 360-367, September 1948.

Gastroscopic studies in twelve patients who had developed post-irradiation gastritis following intensive radiation treatment for malignant disease showed remarkably constant and characteristic gastric changes. The picture included marked edema with tubular deformity and fixation of the

BIOLOGICAL EFFECTS OF RADIATION (Continued)

antrum, similar fixed patulousness of the pylorus, and clean deep chronic ulcers which healed without contracture. Following subtotal gastrectomy with posterior gastroenterostomy, the picture was that of normal postoperative stomach. Pathologic and roentgenographic studies in general corroborated the gastroscopic findings. A new gastroscopic entity is presented, but, because the diagnosis of post-irradiation gastritis should be obvious from the history, the importance of endoscopy lies in the evaluation of the severity of the radiation damage.

1532 What Every Midical Officer Should Know about the Atomic Bomb. Part VI. Pathologic Anatomy of Radiation Effects of Atomic Explosion. Bulletin of the U. S. Army Medical Department 8, p. 422-428, June 1948.

The radiation effects of an atomic explosion on the skin, pituitary, adrenals, heart, lungs, genitourinary system, gastrointestinal tract, spleen, lymph nodes, bone marrow and the reticulo-endothelial system are reviewed. The case history of a man at a distance of 0.7 kilometers from the explosion center is given.

BIOLOGY, GENERAL

1533 The Distribution of Uranium in Tissues of Dogs Administered Uranium Metal or Oxide (U_3O_8) by Oral or Pulmonary Routes, by J. J. Nickson, R. Ferretti, and S. T. Cantril. AECD-2356 (ANL-4190), May 1, 1948, decl. October 22, 1948. 8 p. For publication in NNES.

A study was made of the distribution of uranium in the tissues of 5 dogs given talc, uranium oxide, or uranium metal either orally or by pulmonary insufflation over a period of several months. The animals were sacrificed about 3 years after the last dose was given. High concentrations of uranium were found in the adrenals of all dogs used in this study. All values reported have been corrected for fluorescence quenching.

Oxide vs. metal by pulmonary insufflation: The dog given uranium oxide retained approximately 4 times the amount of uranium in the lung and kidney cortex than did the dog that received metal. The average concentration of uranium in the brain, liver, and spleen was slightly more in the dog that received the metal than in the oxide-treated animal.

Oxide vs. metal by feeding: The concentration of uranium in the kidney cortex of the dog that received the metal was 6 times greater than that of the dog that received the oxide, and the concentration of uranium in the brain tended to be somewhat higher in the oxide-treated dog than in the dog receiving the metal. The concentration of uranium in the bone shaft and rib was much greater in the dog administered the metal than in the dog which received the oxide.

1534 A Study of the Treatment of Plutonium and Radioyttrium Poisoning by Zirconium Citrate, by Jack Schubert. AECD-2358 (ANL-HDY-592), September 1, 1948, decl. October 22, 1948. 23 p. For publication in the Journal of Laboratory and Clinical Medicine.

A study was made of the effect of a single dose of zirconium citrate on the excretion and distribution of plutonium and radioyttrium in rats and a growing dog. It was found that the administration of zirconium citrate to rats increased the excretion of Pu from 1 per cent to 50 per cent and that of Y from 25 per cent to 60 per cent of the injected dose during a 24-hour period. The amount of Pu and Y deposited in the skeleton was reduced by factors of 6 and 2.6 respectively. No significant changes in the Pu or Y contents of the feces, liver, spleen or kidneys were found. The administration of zirconium citrate to a dog 5 months after exposure to Pu was followed by a sustained increase in the urinary excretion of Pu. The extent of the increase was proportional to the dose of zirconium citrate. Two and one-half years after exposure to Pu the infection of a small amount of zirconium citrate was followed by a twofold increase in the urinary excretion of Pu. A discussion is given of the chemical concepts involved in applying metal displacement principles to the removal of radioactive metals from the body.

BIOLOGY, GENERAL (Continued)

1535 Biophysics with Special Reference to Electrobiology, by R. T. Lustig. Office of Military Government for Germany (US) Fiat Final Report No. 884, May 13, 1947. 99 p. (NP-343)

This report reviews German development in ultra short wave therapy and research in dielectric constants and specific resistance of animal and human tissue. Sensitive detectors of infra red, visible light, ultra violet, x-ray, and gamma radiation are described and photostatically illustrated. A new instrument for erythrocyte determinations is described. Other topics discussed are the structure of a microcell for the determination of electrolytic conductivities, a simple quantitative technique for determining radium content of tissue by photo film exposure, an electrostatic generator, ultra sonics in biophysics, ionized air in therapy, infra red application in diagnostic instrument, and roentgen ray shielding methods. 7 references.

1536 A Beryllium Case, by C. F. Shook and J. P. Powell. Industrial Medicine 17, p. 403-404, October 1948.

A woman, aged 35, received an apparently minor and superficial laceration of the anterior surface of the left wrist when a fluorescent lamp fell on a work table in front of her and shattered. The wound healed only partially and continued to break down and discharge a watery solution and a ridge of small tumor-like growths appeared along the wound line. Approximately four months after the accident when the woman came under professional care, there were two small keloid type formations about 1/4 inch in diameter with several smaller areas in between of vascular appearance covered by a thin layer of epidermis which showed evidence of frequent breakdown. There was no exudate. Approximately three months later the lesions were excised and primary suture of the defects performed. A week later when the sutures were removed there was primary union and no reaction in the incision. The patient was to be observed for at least a year for any recurrence of the granulomatosis lesions. The pathological diagnosis was given as: segments of skin with epithelial atrophy and subepithelial intradermic chronic multiple granulomata with central caseation, necrosis, and giant cell formation. It was noted that there was nothing characteristic about the lesion that would specifically differentiate it as having particular etiology.

1537 Beryllium Granulomatosis. Lancet 255, p. 535-536, October 2, 1948.

The characteristic lesion in chronic or delayed pneumonitis caused by beryllium and its compounds is a granuloma in the lungs. It produces x-ray shadows resembling those of some forms of pneumoconiosis, miliary tuberculosis, and sarcoidosis. This leads to some diagnostic confusion if the patients' histories are not known. Granulomatous changes are also found in the liver and, in some cases of people who have cut themselves on broken fluorescent lamps, subcutaneously. Histologically these granulomata resemble the skin lesions which develop in cases of pulmonary granulomatosis. They are also very similar to sarcoidosis of the skin. At present the treatment of the disease is ineffectual, the prognosis is bad, and the disability is serious and permanent.

1538 Delayed Pneumonitis in a Beryllium Worker, by John N. Agate. Lancet 255, p. 530-533, October 2, 1948.

In this case, which appears to be the first case of delayed chemical pneumonitis in a beryllium worker to be reported in England, a laboratory worker developed a chronic pneumonitis three years after exposure to zinc beryllium manganese silicate dust during the making of fluorescent lamps. Cough, dyspnea, and extreme loss of weight were the chief clinical features. Radiographs showed extensive bilateral pulmonary disease, and drill biopsy of the liver showed focal granulomatous areas scattered throughout the tissues without any biochemical evidence of liver disorder. The patient has not improved since admission to hospital. Treatment, if any, is not reported.

BIOLOGY, GENERAL (Continued)

1539 Environmental Studies in Plants and Laboratories Using Beryllium: the Acute Disease, by Merril Eisenbud, C. F. Berghout, and L. T. Steadman. Journal of Industrial Hygiene and Toxicology 30, p. 281-285, September 1948.

Several hundred air samples from three American plants producing beryllium compounds were collected on filter paper and analyzed spectrographically. The compounds studied were beryllium sulfate, oxide, fluoride, hydroxide, metallic dust, and beryl. Those definitely shown to cause acute pneumonitis are the sulfate, fluoride, oxide, and metallic dust. The hydroxide is thought to be capable of producing the acute disease due to its similarity to the oxide; this was not demonstrated conclusively because no workers were found who had been exposed exclusively to the hydroxide. Beryl was not found to cause acute toxicity. The toxicity of the oxide appears to be extremely variable, depending on a number of factors such as particle size, surface area, and temperature of processing. Many acute cases have resulted from a single excessive exposure. In the case of the fluoride, an exposure of twenty minutes duration is known to have produced three cases of acute pneumonitis. Quantitative data are given as to the concentrations which existed during this episode. 10 references.

1540 Forty Years in the Poisonous Trades, by Alice Hamilton. American Industrial Hygiene Association Quarterly 9, p. 5-17, March 1948.

In this review of the development and problems encountered in industrial medicine, beryllium (p. 11) is named as the newest of industrial poisons of practical importance, and the contributions of such investigators in the field of beryllium poisoning as Hardy, Gelman, Van Ordstrand, Hughes, Carmody, Tabershaw, Martland, and Gardner are noted.

1541 International Congress of Industrial Medicine. Lancet 255, p. 504-506, September 25, 1948.

Among the papers presented at this congress were the following. Professor A. Policard (France) spoke on his animal experiments on the effect of beryllium in the lungs. He found that beryllium sodium fluoride dusts provoke early and violent pulmonary oedema, resulting in death of the animals within 24 hours. Beryllium oxide dusts, on the other hand, cause hyperplasia of the mesenchyma of the lung tissue. Three types of reaction are found, the first being histiocyte pneumonia, the second granulomatous nodules, often with giant-cell formation, and the third cellular thickening of the alveolar walls. The granulomatous nodules seen after a few weeks' exposure persist for several months. Metallic beryllium and beryl do not seem to affect the lungs of animals. Dr. Herman Lisco (U. S. A.), speaking on the potential hazards and pathological aspects of radioactive isotopes, said that more use of radiant energy will in future be made by private research laboratories, government agencies, and in industry arising out of the peace-time developments of atomic energy.

1542 The Toxicity of Some Zirconium and Thorium Salts in Rats, by L. T. McClinton and Jack Schubert. Journal of Pharmacology and Experimental Therapeutics 94, p. 1-6, September 1948. (See also MDDC-1636)

The acute toxicity in rats of the citrate and gluconate salts of zirconium and the citrate salt of thorium have been studied. The salts were administered by intraperitoneal injection at frequent intervals for not more than 20 hours in large doses and, in the cases of zirconium citrate, in divided doses over a period of two to eight days. The LD-50 and the standard errors for the experiments where the animals received large frequent doses of the above salts were determined. Rats which survived 36 hours following the large frequent doses of the zirconium and thorium salts invariably recovered and exhibited no toxic symptoms 6 months later. No hematologic or histologic effects of zirconium (citrate) were found. As much as 3,600 mgm/kgm of zirconium (citrate) was tolerated by rats when administered by intraperitoneal injection once daily in doses of 450 mgm/kgm. 6 references.

CERAMICS

1543 The Volatilization of BeO in the Presence of H_2O, by Clyde A. Hutchison, Jr. and John G. Malm. AECD-2345 (ANL-HDY-554), October 1947, decl. October 20, 1948. 3 p. For publication in Journal of the American Chemical Society.

Previously obtained equilibrium vapor pressures of BeO are too low to account for the relatively rapid volatilization observed when BeO is used as a refractory. This experiment shows that the volatilization is due to the presence of H_2O vapor. Reaction of H_2O with BeO results in the formation of a volatile compound at temperatures of 1250°C or greater. This volatile substance condenses with decomposition to BeO. The volatilization rate increases with increasing temperatures.

1544 The Production of Zirconium Oxide, by Malcolm H. McAllister. Office of Military Government for Germany (US) Fiat Final Report 1048, January 31, 1947. 9 p. (NP-256)

This report describes production of high purity zirconium oxide as practiced by the Oranienburg Plant of Auergesellschaft A. G., using as raw materials both zircon sand and favas.

1545 Quarterly Progress Report on the Investigation of Refractory Materials. Pennsylvania State College School of Mineral Industries Memorandum Report No. 13 (Air Material Command Contract), August 12, 1947. 32 p. (NP-433)

General progress in the preparation and examination of new refractory products and in the heat-shock testing of ceramic bodies is reported. Body mixtures involving the materials BeO, specially selected beryl, artificially prepared willemite, zircon, magnesia, lithia, zinc oxide, nickel oxide, calcia, strontia, and alumina were investigated for heat shock resistance using a standard size disk.

The following conclusions were made: The following compositions are worthy of further study: 70% refractory grade BeO, 30% special grade natural beryl; 70% synthetic willemite, 30% milled zircon; 70% milled zircon, 30% refractory grade BeO; 85% refractory grade BeO, 15% milled zircon; 95% milled zircon, 5% NiO; 85% NiO, 15% milled zircon; 100% A-10 Alumina (Alorco). Research on the binary refractory system thoria-chrome oxide indicates the possible existence of a compound. The expansion of aluminum titianate was found to be moderately low and the compound itself is highly refractory. Investigation of the refractory binary systems ZrO_2 - SnO_2 and ZrO_2 - TiO_2 revealed no new compounds between the oxides. No new compounds were revealed by a study of the system ThO_2 - ThP_2O_7. Compounds $2Li_2O \cdot ZrO_2 \cdot SiO_2$ and $2MgO \cdot ZrO_2 \cdot SiO_2$ may exist in the ternary systems. The lithia compound is not sufficiently refractory for use as a heat resising body. 9 references.

1546 Quarterly Progress Report on the Investigation of Refractory Materials. Pennsylvania State College School of Mineral Industries Memorandum Report No. 16 (Air Material Command Contract), May 15, 1948. 33 p. (NP-420)

General progress is reported in the synthesis and examination of properties of various oxides and carbides suitable for high temperature refractories. Research in one-component systems included the study of ZrO_2. The following two-component systems were studied: ZrO_2 - SiO_2; BeO - SiO_2; BeO - Al_2O_3; BaO - Al_2O_3; CoO - Al_2O_3; NiO - ZrO_2. Three-component systems reported on are MnO - Al_2O_3 - SiO_2; Al_2O_3 - Al - Al_4C_3; and SiO_2 - Si - SiC. The following conclusions were reached: Electrically fused zirconia is less susceptible to stabilization by the usual oxides than the lightly calcined C.P. material. Transverse strength tests on zircon bars indicate a rapid decline in strength with increase in temperature of previous heat treatment. Addition of RO type oxides improves this strength. Synthetic phenacite shows moderate regular expansion but decomposes near 1560°C. Synthetic chrysoberyl bodies develop high strength, especially upon addition of small amounts of Cr_2O_3. The compounds $BaO \cdot Al_2O_3$ and $CoO \cdot Al_2O_3$ are formed near 1400°C and show relatively high thermal expansion coefficients. No compounds were found in the system NiO - ZrO_2; evidence of possible stabilization of ZrO_2 by NiO also was lacking. Manganese "cordierite" has no value as a refractory. Synthesis of aluminum carbide takes place at a lower temperature from metal and carbon than from

CERAMICS (Continued)

oxide and carbon. At temperatures near incipient carbide formation, a distortion of the aluminum oxide lattice is indicated, with several modifications of alumina in evidence. There is no evidence of formation of SiC from the oxide and carbon at 1500°C. Cubic SiC is readily formed at 1500°C from silicon metal and carbon. 11 references.

1547 Refractory Insulating Coatings for Metals; Quarterly Report No. 6, January 1 - March 31, 1948. Rutgers University (Air Material Command Contract), n.d. 19 p. (NP-429)

An attempt is made to provide a highly refractory, essentially glass-free coating on metal by means of a graded metal bond. A number of coats are applied to the base metal by brushing or spraying, each successive coating being somewhat different in composition with respect to the percentage of powdered metal and ceramic. The coating adjacent to the base metal is pure metal powder and in each successive coating, the ratio of metal to ceramic decreases, until the final layer consists of 100% ceramic. The metal, thus coated, is heated in a hydrogen atmosphere to sinter the powdered metal together and to the base metal, and to lend strength to the ceramic component.

Some of the ceramic materials and powder metals studied were MgO and nickel, MgO and cobalt, feldspar and nickel, SiC and cobalt, porcelain and nickel, strontium zirconate and nickel. It was concluded that the methods outlined may be used to produce high magnesia coatings on metals.

1548 Reactions of Molten Titanium with Certain Refractory Oxides, by Porter H. Brace. Journal of the Electrochemical Society 94, p. 170-176, October 1948.

A qualitative study was made of the effect of molten titanium metal in vacuo on Al_2O_3, BeO, and ThO_2. The reaction of molten titanium was strong with Al_2O_3, noticeable with BeO, and slight but perceptible with ThO_2. Hammer tests were used to compare the titanium samples, and it is seen that reduction of the oxides proceeds far beyond the limits that might be expected from the oxygen dissociation pressures as calculated for the oxides at the melting point of titanium. It is suggested that intermetallic compound formation may account for the great reducing power of molten titanium. Al_2O_3 and BeO are useless as titanium crucibles, while ThO_2 shows some promise.

CHEMISTRY, ANALYTICAL

1549 The Determination of Hydrogen - A New Universal Microgasometric Method, by Leonard P. Pepkowitz and Everett R. Proud. AECD-2365, n.d., decl. October 29, 1948. 18 p. For publication in Analytical Chemistry.

A method is presented for the determination of hydrogen in organic, inorganic, metal-organic compounds and low melting metals. The basis of the method is the evolution of the hydrogen in the sample within a sealed iron capsule and the complete diffusion of the liberated hydrogen through the walls of the capsule into a simple vacuum system. The procedure is rapid, a complete determination can be made within an hour. The average error (0.2%) is comparable with that of the standard combustion procedure (0.3%). There are no interferences from other elements.

1550 The Colorimetric Determination of Rhenium, by K. A. Allen and B. S. Weaver. Carbide and Carbon Chemical Corporation Y-12 Plant Report Y-258, October 18, 1948. 10 p.

The chemical processing of rhenium in the separation of its isotopes required more reliable analyses than those obtainable by the standard colorimetric thiocyanate method. The effects of concentrations of reagents used in this method were studied over wide ranges. Optimum conditions were determined with consequent great improvement in sensitivity and accuracy of this determination. Excellent results were obtained by diethyl ether extraction of the rhenium complex followed by evaporation and solution in water. Tables are included which show the effect produced on the stability of the rhenium oxythiocyanate complex by iron, H_2SO_4, HCl, $SnCl_2$, and KSCN. A diagram of the continuous diethyl ether extractor is given.

CHEMISTRY, ANALYTICAL (Continued)

1551 An Instrument for Controlled-Potential Electrolysis, by R. W. Lamphere and L. B. Rogers. Oak Ridge National Laboratory Report ORNL-117, August 3, 1948. 27 p.

Electrodeposition is a common method for the separation and determination of many elements present in solution, because an electrolysis involves only a few simple operations, and because it can be easily carried out by remote control, the method is a very promising one for the separation of radioactive elements. An instrument is described which will hold the cathode-solution potential to ± 2 mv over a 24 hour period. It will supply up to 18 volts and 1 ampere to the cell. It controls equally well for either increasing or decreasing potential. The cathode-solution potential may be either positive or negative with respect to the reference half-cell. Oscillograms have been recorded to illustrate rapid fluctuations in cell potential which on rare occasions may be encountered in attempting to control cathode-solution potentials.

1552 Application of Paper Chromatography to the Estimation of Free Amino Acids in Tissues, by Jorge Awapara. Archives of Biochemistry 19, p. 172-173, October 1948. (Letter to the editors)

Paper Chromatography has been used successfully in the analysis of free amino acids in rat tissues. Freshly minced tissues were homogenized with five volumes of hot water in a Waring blender. Enough absolute alcohol was added to precipitate all the proteins. The precipitate was centrifuged down and the clear supernatant removed and mixed with three times its volume of chloroform and centrifuged. Recovery of amino acids is better than 90% by this method. The extract was concentrated to at least 5-fold (of its volume) and chromatographed using phenol. Analysis of the heart, kidney, liver, and spleen gave remarkably similar results. All contained aspartic acid, glutamic acid, glycine, and alanine. Their identities were verified by acid hydrolysis following elution of these four fractions from the paper and then by rechromatography with known solutions.

1553 Chromatography, by Harold G. Cassidy, Norman Applezweig, Stig Claesson, Victor R. Deitz, Beveridge J. Mair, A. J. P. Martin, Stanford Moore, Robert L. Peck, W. A. Schroeder, Leo Shedlovsky, William H. Stein, Henry C. Thomas, and L. Zechmeister. Editor, Roy Waldo Miner; Consulting Editor, Harold G. Cassidy; Associate Editor, Lothar Salin. Annals of the New York Academy of Sciences 49, Art. 2, p. 141-326, 1948.

This monograph is composed of a series of papers given at a Conference on Chromatography held by the Section of Physics and Chemistry of the New York Academy of Sciences. The papers are written by recognized authorities in the field and cover the following general topics: history, scope and methods of chromatography, theoretical considerations, partition chromatography, and the application of chromatography to the separation of specific substances such as hydrocarbons, stereoisomers, amino acids and streptomycin.

CHEMISTRY, GENERAL

1554 Isotope Effect in the Thermal Cracking of Propane-1-C^{13}, by D. P. Stevenson, C. D. Wagner, O. Beeck, and J. W. Otvos. Journal of Chemical Physics 16, p. 993-994, October 1948.

Significant differences were found in the reactivities of bonds to terminal C^{13} and C^{12} atoms by investigating the pyrolysis of propane. An 8% more frequent rupture of C^{12}-C^{12} bonds than of C^{12}-C^{13} bonds was observed. Tables showing mole fractions of heavy products and material balance are given.

CONTROL OF ATOMIC ENERGY

1555 Atomic Impasse 1948: A Collection of Speeches by Frederick Osborn, Deputy United States Representative to the United Nations Atomic Energy Commission—Department of State. Washington, D. C., Government Printing Office, 1948. 48 p.

The ideas expressed here, the author says, are "a reaction to being faced with a dreadful problem in close association with a group of able men from diverse nations striving urgently for a solution." Chapter headings are as follows: Public Opinion versus Soviet Secrecy; The Iron Curtain Bars Atomic Agreement; Communist Premises, Method, and Organization Deny the Possibility of Cooperative Agreement; Dangers of Concentrated Power; The Forum of World Opinion; American Education and Soviet Propaganda; United States Foreign Policy and the Atomic Weapon.

CORROSION AND ANTI-CORROSION

1556 Application of Electron Diffraction Techniques to the Study of Corrosion Processes, by E. A. Gulbransen. Corrosion 4, p. 445-455, September 1948.

The study of the nature of the protective or non-protective corrosion films on metals and alloys by using electron diffraction techniques is described. The general theory of electron diffraction is discussed and schematic diagrams are given. Results of several experiments are listed and patterns are given.

1557 Corrosion Resistance as well as Other Properties of Titanium Metal Make It an Attractive Material, by Mars G. Fontana. Industrial and Engineering Chemistry 40, No. 10, p. 99A-100A, October 1948.

The author lists some of the mechanical properties of titanium and presents corrosion data in several concentrations of sulfuric, hydrochloric, nitric, and acetic acids for pure titanium and an 89% Ti-11% Cr alloy. The pure titanium showed good corrosion resistance against acetic and nitric acids, while the resistance to hydrochloric and sulfuric acids was poor. The high reactivity of titanium makes the production difficult. Unreactive high temperature refractories maust be developed. It is mentioned that the 89% Ti-11% Cr alloy has a higher strength-weight ratio (31,200) than any other metal or alloy.

1558 Systematic Investigation of Corrosion Inhibitors, by de Decker, Amsterdam, Holland. Paper before Journees Metallurgiques d'Automne, Fall Metallurgical Conference Sponsored by Soc. Francaise de Métallurgie and Comm. Tech. des Etats de Surface, Paris, October 6-10, 1947. (Abstract in French)

The general superficial corrosion is determined as a function of inhibitor concentration, the slopes indicating inhibitor effect. The importance of pits is considered.

1559 The Theory of Corrosion Phenomena. Part XVIII. The Basis of the Local Element Electrochemical Explanation of Corrosion Processes, by W. J. Müller. Korrosion und Metallschutz unter Einbeziehung des allgemeinen Werkstoffschutzes 16, Nos. 1-2, 1-10, 1940.

The author develops a local surface cell theory of corrosion. The relationships existing between current density, electromotive force, and resistance of the developed cells are discussed.

COSMIC RADIATION

1560 The Effect of the Earth's Magnetic Field on Large Auger Showers, by V. V. Vladimirski. Zhurnal Eksperimental 'noi i Teoretichskoi Fiziki 18, p. 393-401, 1948. (In Russian)

The spectrum of a decelerating radiation of fast electrons in the magnetic field of the earth is examined. The influence of the multiplication of the decelerating quanta in the atmosphere on the total number of particles in an Auger shower, induced by electrons, is determined. If the energy of the primary electron is greater than 2×10^{18} ev, the decelerating quanta give more particles at sea level than a primary electron retarded by the earth's field.

1561 The Effective Path Length Through a Vertical Cosmic-Ray Telescope, by Enos E. Witmer and Martin A. Pomerantz. Journal of the Franklin Institute 246, p. 293-309, October 1948.

The average path length through a vertical cosmic-ray telescope is determined to obtain a factor for converting the measured thickness of the interposed material to effective thickness as regards absorption properties. It is necessary to make this correction, since due to the finite aperture of the counter train, the total path lengths traversed by the detected cosmic-ray particles will vary in length. The results obtained by the author indicate that this correction is not always negligible and that it is of particular importance when comparing results obtained with different counter trains. The dependence of path length upon zenith angle for unidirectional cosmic rays is used to derive and calculate the required expressions. Only arrangements in which the dimensions of the uppermost tray and the lowest tray are the same are considered. The ratio of average path length to normal path length is plotted as a function of the ratio of counter length to the vertical separation between extreme counters, for various indicated laws of cosmic ray intensity dependence on zenith angle. These curves are applicable only when the counter diameter is negligible compared with its length. Another family of curves is shown which takes into account the tray width. The results may be summarized as follows: (1) the average path length through a vertical coincidence counter train is not greatly affected by a change in the zenith angle distribution law, provided the separation between extreme trays is roughly comparable with the dimensions of the trays; (2) even for geometrical arrangements which intuitively appear to be unsatisfactory (as regards angular definition and the possible complicating effects arising from the distribution of allowed path lengths) the departure of the average path length from the vertical path length may be rather small.

1562 The Existence in Cosmic Rays of Positive and Negative Particles with a Mass Greater than the Mesotron Mass, by A. Alikhanyan, A. Alikhanov, and A. Vaisenberg. Zhurnal Eksperimental 'noi i Teoretichskoi Fiziki 18, p. 301-336, 1948. (In Russian)

The momentum spectra of particles of cosmic radiation were studies by the method of magnetic deflection at an altitude of 3250 m. It is shown that among the particles whose ranges are not greater than 5.4 cm of lead there are particles of both negative and positive charge the mass of which lies between that of the meson and the proton. From the observed trajectories of the particles the existence, to some degree, of particles of mass 500, 1000, and 2000 m_e must be assumed.

1563 Genetically Bound Impulses Induced by Cosmic Rays, by N. Dobrotin and V. Tsyrlin. Zhurnal Eksperimental 'noi i Teoretichskoi Fiziki 18, p. 268-274, 1948. (In Russian)

Experiments at the height of 3860 m indicate that the main part of the coincidences observed in a vertically distributed group of proportional counters cannot be ascribed to showers, but must be due to genetically associated secondary particles formed as a result of the interaction of the cosmic radiation with matter.

COSMIC RADIATION (Continued)

1564 Investigation of the Penetrating Ability of Particles of Atmospheric Showers of Cosmic Rays, by G. T. Zatsepin and L. Kh. Eidus. Zhurnal Eksperimental 'noi i Teoretichskoi Fiziki 18, p. 259-267, 1948. (In Russian)

The absorption in aluminum and lead of particles of wide atmospheric showers at a height of 3860 m above sea level was investigated by means of counters. Particles of the shower penetrating 12 cm of lead were identified with the electron-photon component of high energy of Auger showers. Some evidence was obtained of the possibility of the existence of wide showers of mesons of small density. On the basis of the study of the penetrating ability of the particles of narrow showers, the authors deducted the existence of two forms of particles in these showers.

1565 Nuclear Fission and Heavy Particles in Cosmic Rays, by A. N. Gorbunov. Zhurnal Eksperimental 'noi i Teoretichskoi Fiziki 18, p. 275-279, 1948. (In Russian)

Heavy, highly-ionizing particles of cosmic radiation were studied by means of double proportional counters at the height of 3860 and 4700 m above sea level. It is found that nuclear fissions produced by the cosmic radiation are generated more readily in heavy substances (lead) than in light substances (aluminum). Nuclear disintegrations are produced to a considerable extent by radiation penetrating 10 cm of lead, but the increase of nuclear disintegrations with height is faster than the increase of the hard component of cosmic rays. An estimate is given of the current of the penetrating particles which produce disintegration, and also the effective absorption cross section in different materials. The neutrality and non-stability of the generating particles are calculated from these estimates.

1566 Origin of Cosmic Ray Stars, by E. P. George. Nature 162, p. 333, August 28, 1948. (Letter to the editors)

The range of the star-producing component of cosmic radiation (gm/cm^2) is three times as large in lead as it is in air. The author's calculations show that this may be due to the difference in atomic weight. The primaries may then be assumed to be stable particles. A comparison of available data with calculations shows that the cosmic ray stars may be caused by fast neutrons, as assumed.

1567 Penetrating Particles in Extensive Air Showers, by J. E. Treat and K. I. Greisen. Physical Review 74, p. 414-423, August 15, 1948.

By means of shielded and unshielded counters, penetrating particles in air showers were studied at 4300- and 3260-m elevation. The experiments show that many penetrating particles are contained which cannot be mesons from the top of the atmosphere, because their density diminishes too rapidly with atmospheric depth and increasing lead thickness. It is furthermore seen that the penetrating particles are not produced multiply in lead shields above the counters. Indications are that these particles are not produced by photons.

1568 The Structure of the Penetrating Atmospheric Showers of Cosmic Rays, by L. N. Bell. Zhurnal Eksperimental 'noi i Teoretichskoi Fiziki 18, p. 249-258, 1948. (In Russian)

The structure of wide atmospheric showers is investigated by the method of flat proportional counters. The data obtained are inconsistant with the assumption of the existence of a separate type of penetrating shower and indicate the existence of a genetic relationship between these showers and the Auger showers. The coincidences observed cannot be explained by high energetic electrons of the Auger showers which obey only cascade laws. A series of data indicate that particles, detected under lead, are formed in lead.

COSMIC RADIATION (Continued)

1569 Utilization of Chance Coincidences for the Measurement of Great Intensities in Work with Counters, by M. I. Podgoretski and V. A. Khvoles. Zhurnal Eksperimental 'noi i Teoretichskoi Fiziki 18, p. 402-407, 1948. (In Russian)

A new method for measuring large intensities is described. In this method a statistical scheme is included after the counter. The theory of the method and an experimental set-up is described.

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

1570 Electronic States in Perturbed Periodic Systems, by Hubert M. James. Oak Ridge National Laboratory Report ORNL-114, August 3, 1948. 21 p.

Recent work on the solid state has directed increasing interest on the motion of electrons in imperfect crystals. Electrons in real crystals move in potential fields which deviate from perfect periodicity for many reasons such as imperfections in the crystal, missing or foreign atoms in the lattice, and termination of the crystal at free surfaces. These deviations from periodicity, if not too extensive, do not greatly disturb the band structure of the permitted energy values. Experiment and theory have made it clear that they may give rise to electronic states with energies outside the permitted bands — states in which the electron can not move freely through the crystal, but is restricted to a limited range near the surface or crystal cell where the periodicity is disturbed.

A quite different type of deviation from periodicity occurs where there is a foreign atom in a crystal lattice. The potential is profoundly modified in the crystal cell which contains this atom. In addition, if the net charge in this cell (due to all charges except the electron under consideration) is different from that in other cells, then the periodicity of the potential through the whole crystal is modified by the coulomb potential of the excess charge. The corresponding one-dimensional wave equation is given. In the work reported, attention has been centered on the development of a more satisfactory method for the solution of this equation. Basically, the method involves constructing solutions for a single period of the periodic part of the potential, and piecing them together to form a solution of the wave equation. The new formulation of the idea employed in the present work has proved to be especially convenient, being suited for discussions of the general features of the problem, and equally so for the study of special details; it appears also to be ideal when numerical calculations are to be made. In this paper its application to perfectly periodic potentials is discussed. A proof is given (one-dimensional case only) for the existence of a band structure in the permitted energies of particles moving in a periodic potential.

1571 Electronics States in Perturbed Periodic Systems, by Hubert M. James. Oak Ridge National Laboratory Report ORNL-114 (Suppl. 1), October 13, 1948. 31 p.

Supplementary to ORNL-114 the following discussions are presented: effective moment in a periodic potential; motion of a wave packet in a periodic potential; semi-classical discussion of motion of particles; qualitative wave discussion of the motion of particles; reduced-mass wave equation.

1572 An Adjustable Curved Crystal Monochromator for X-Ray Diffraction Analysis, by P. M. DeWolff. Applied Scientific Research B 1, p. 119-126, 1948.

The logarithmic spiral form of Barraud's monochromator can be obtained to a good approximation by exerting unequal bending moments on the short edges of a rectangular crystal plate. Some aberration formulas are derived pertaining to the asymmetrical Barraud-type monochromator. (Comptes Rendus 214, p. 795, 1942). A new way of mounting is described. Calculations are made which indicate only negligible aberration in a monochromator thus constructed and used by the author. Practical advantages, such as absence of high precision work in making the crystal holder and the fact that the monochromator can easily be set to a large range of wave lengths, are discussed.

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE (Continued)

1573 Affinity of Oxygen Molecule for the Electron, by I. A. Kazarnovskii. Doklady Akademii Nauk SSSR 59, p. 67-70, January 1, 1948. (In Russian)

Attempts which have been made by several authors to determine the affinity of the oxygen molecule for the electron have given divergent results. The present writer shows a new approach to the problem by studying the lattice energy of KO_2, RbO_2, and CsO_2, where the ion O_2^- can be visualized as an elongated ellipsoid of revolution with a central point charge. Since a particle of this shape is an electron quadrupole, its potential was taken into consideration when calculating the lattice energy. A value of 22 ± 10 kcal for the affinity of the oxygen molecule for the electron was obtained.

1574 Crystal as a Many-Electron Problem and Its One-Electron Approximation, by S. I. Pekar. Zhurnal Eksperimental 'noi i Teoreticheskoi Fiziki 18, 525-532, 1948. (In Russian)

It is shown that not every solution of the Hartree-Fock equation has a physical significance since these equations have a considerably larger number of solutions than corresponding exact Schrodinger equations. The known self-consistent solution of the type $\psi_k(r) = U_k(r)\, e^{ikr}$ in the majority of cases is found among the solutions not having physical significance. In those cases, self-consistent solutions having physical significance are indicated. At the same time a crystal is examined as a multi-electron problem.

1575 Crystal Texture and the Determination of Structural Amplitudes, by W. A. Wooster and G. L. MacDonald. Zhurnal Eksperimental 'noi i Teoretichskoi Fiziki 18, p. 285-292, 1948. (In Russian)

Absolute measurement of the integral reflection from definite planes of calcite, quartz, gypsum, and fluorspar were made using the copper and molybdenum characteristic radiations. An experimental method is described which permits the determination of the structural amplitude in spite of the large differences in the integral reflection associated with large differences in the degrees of imperfection of different samples of the same crystal. It is shown that if the degree of imperfection of a given sample is to be expressed by the magnitude of the integral reflection, then it is necessary to use more than one wave length of x-rays.

1576 Dispersion of Anthracene Crystals in the Visible, by I. V. Obreimov, A. F. Prikhot'ko, and I. V. Rodnikova. Zhurnal Eksperimental 'noi i Teoretichskoi Fiziki 18, p. 409-418, 1948. (In Russian)

The three principle indices of refraction for crystals of anthracene have been determined for several wave lengths of visible light. A two-membered formula for dispersion is given. It is clear from this formula that the violet band of the anthracene belongs to strong absorption bands with a vibrator strength of about 1.

1577 Electron Density in Nickel, by N. V. Ageyev and L. N. Gusev. Doklady Akademii Nauk SSSR 59, p. 65-66, January 1, 1948. (In Russian)

The atomic factor of scattering in nickel was determined photographically for flat samples, with the aid of cobalt and copper radiations. Reduction to absolute values was made by the method of substitution, with aluminum powder as etalon. The obtained curve was used for the calculation of the electron density in the nickel lattice, by Fourier's triple series method. "Bridges" of higher electron density unite each atom with its neighbors: the "bridge" density is 1.1 el/A^3, while that of an interior space is 0.4 el/A^3.

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE (Continued)

1578 Luminescence and the Distribution of the Local Energy Levels in Photochemically Colored Alkali-Halide Crystals, by M. L. Kats. Zhurnal Eksperimental 'noi i Teoreticheskoi Fiziki 18, p. 501-509, 1948. (In Russian)

The distribution of localized energy levels in crystals of NaCl, KCl, and KBr produced by x-ray irradiation at low temperatures in investigated by glow curves in the ultraviolet and visible spectra. Using these glow curves a calculation is made of the energy of activation, i.e., the relative depth of the localized energy levels relative to the conduction zone and the upper filled energy bands. The mechanism of the glow curves of colored alkali-halide crystals in the ultraviolet and visible spectrum is given.

1579 Quantum-Mechanical Consideration of the Dynamics of Crystallic Lattice, by S. V. Tyablikov. Zhurnal Eksperimental 'noi i Teoretichskoi Fiziki 18, p. 368-373, 1948. (In Russian)

Starting with quantum equations of motion for N bodies, an investigation is made of the dynamics of a crystalline lattice. The first approximation leads to the results of the Born theory of the lattice. The results of the second approximation probably show some peculiarities of the spectra.

1580 Quantum States and Optical Transitions of Electrons in Polarons and in Color Centers of Crystals, by S. I. Pekar and M. F. Deigen. Zhurnal Eksperimental 'noi i Teoreticheskoi Fiziki 18, p. 481-486, 1948. (In Russian)

An investigation is made of polarons — electrons, auto-localized in ideal ion crystals — and of color centers in crystals (alkali-halide crystals) using a model developed by one of the authors in a previous article. Calculations are made of the energy levels, the ψ functions of the electron and the oscillator strength of the optical transitions.

1581 The Scattering of Short Elastic Waves in the Crystal Lattice, by I. M. Lifshits. Zhurnal Eksperimental 'noi i Teoretichskoi Fiziki 18, p. 293-300, 1948. (In Russian)

The scattering of very short elastic waves in the crystalline lattice is investigated in terms of single obstructions (scattering centers). The amplitudes of the scattered waves and the form of the wave surface are linked by formulas with the laws of dispersion.

1582 Stability of Crystallographic Lattices, by B. Zhdanov and L. Tikhonova. Zhurnal Eksperimental 'noi i Teoreticheskoi Fiziki 18, p. 552-558, 1948. (In Russian)

The stability of the atomic cubic face-centered crystal lattice is examined under the influence of a one-sided elongation and a compression. It is shown that the destructions of the lattice on elongation and compression have essentially different characters, and that the lattice resists compression less than elongation.

1583 The Theory of the Crystal State, by A. S. Pereleshin. Zhurnal Eksperimental 'noi i Teoreticheskoi Fiziki 18, p. 449-456, 1948. (In Russian)

A crystal, obtained in the scheme of the kinetic equation of A. A. Vlasov, is examined. It is shown that, starting with a certain minimal temperature, the periodic distribution of the density in such a crystal is discontinuously violated and that this violation is retained at further increase in temperature.

1584 Vibration Amplitudes of Atoms in Cubic Crystals, by Kathleen Lonsdale. Acta Crystallographica 1, Part 3, p. 142, July 1948.

Root-mean-square amplitudes of atomic vibrations are given for 20 elements and 24 compounds crystallizing in the cubic system. The spatial distribution of atomic displacements due to thermal

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE (Continued)

vibration is calculated from the elastic constants of 19 cubic crystals; attention is drawn to the relationships existing between amplitude of pure longitudinal and transverse waves travelling along the cube edges, face diagonals and cube diagonals, and the structures of these crystals. From these data the intensity of the diffuse scattering power can be plotted in reciprocal space, for comparison with experimental data from monochromatic Laue photographs. Some of the data for the R-MS amplitude of atomic vibration at 293°K are given below.

	A	θ	$\overline{u}^2$	$\sqrt{(\overline{u}^2)}$	Structure type
Ge	72.6	290	0.021	0.145	A 4 (diamond)
Mo	96.0	380	0.010	0.10	A 2 (b.c.c.)
Ta	180.9	245	0.012	0.11	A 2 (b.c.c.)
W	183.9	310	0.0075	0.08	A 2 (b.c.c.)

42 references.

DEUTERIUM

1585 Mass Spectrometric and Infra-Red Study of Rates of Deuterium Exchange Isomerization, and Hydrogenation of the n-Butenes, by Vernon H. Dibeler and T. Ivan Taylor. Journal of Chemical Physics 16, p. 1008-1009, October 1948. (Letter to the editor)

The "hydrogen switch" mechanism proposed by Turkevich and Smith (Journal of Chemical Physics 16, p. 466, 1948) for isomerization and tritium exchange is supported by this investigation of the rate constants of the initial stages of deuterium exchange, isomerization, and hydrogenation of the n-butenes. The rates of formation of deuterobutenes and butane were observed by mass spectrometric means, while the infra-red absorption at 925 cm^{-1} enabled the observation of the isomerization rate of 1-butene to 2-butene. In the initial stages of the reaction between deuterium and 1-butene, between 93°C and 130°C, the rate of isomerization was only slightly greater than the rate of exchange. Activation energies for isomerization and exchange were 7.8 ± 0.7 kcal. and 7.1 ± 0.7 kcal., respectively, giving support to the idea that each isomerization is accompanied by an exchange. The course of the reaction was followed and the various relative rate constants are given. The addition and isomerization-exchange mechanisms are seen to be different. More complete results will be published later.

1586 Solubility of Salts in Deuterium Oxide, by Evan C. Noonan. Journal of the American Chemical Society 70, p. 2915-2918, September 1948.

In order to obtain a better understanding of electrolyte behavior in light and heavy water, the solubilities of the following 12 salts were studied in light and heavy water mixtures: silver chlorate, thallous perchlorate, potassium permanganate, thallous nitrate, potassium dichromate, sodium bromate, potassium argentocyanide, cesium nitrate, potassium chlorate, mercuric cyanide, sodium oxalate, and lead chloride. These salts were chosen since they have a high temperature coefficient of solubility, do not form solid hydrates, are easily purified, and are stable to hydrolysis and to oxidation by air. Solubility data from 5° to 35°C in light and heavy water mixtures are given in tabular form for the silver chlorate, thallous perchlorate, potassium permanganate, thallous nitrate, and potassium dichromate. Solubilities are from 15 to 33% less than in light water. Solubilities in water-deuterium oxide are given at 5°C for cesium nitrate, potassium silver cyanide, potassium chlorate, sodium bromate, sodium oxalate, and mercuric cyanide. The lead chloride and potassium dichromate solubilities are given at 25°C.

FLUOROCARBONS

1587 Correlation of the Physical Properties of Fluorothene with Temperature and Pressure of Molding, by A. E. Johnson and T. Cantwell. Carbide and Carbon Chemicals Corporation K-25 Plant Report No. K-276, August 13, 1948. 23 p.

The attack by corrosive gases on the gaskets used in the lines in the K-25 plant made it desirable to find some material, probably a plastic, which could not only stand the wear and tear of ordinary usage, but also withstand this attack. The final product of the investigation into this problem was the discovery of fluorothene, which is a polymer of 1,1,2 tri-fluoro-2-chloro-ethylene. Although it is believed to be a two dimensional polymer, and this belief is upheld by the fact that it is thermo-plastic, there has not been found as yet a volatile solvent for it, which indicates three dimensional characteristics. There is no effect by any of the stronger acids or bases upon fluorothene. A study of the effect of molding pressure and temperature on the tensile strength, hardness, and transparency of fluorothenes plastic revealed that tensile strength is but slightly affected and that hardness and transparency are not noticeably affected at all by changes in these molding conditions. It was discovered that application of sufficient tensile load increases the transparency of the fluorothene.

1588 The Development of Fluorine Chemistry, by H. J. Emeléus. Endeavour 7, p. 141-147, October 1948.

The author reviews in a general manner the development and production of fluorine compounds.

1589 A Grignard Reagent from 3-Chloro-1,1,1-trifluoropropane, by E. T. McBee and Anthony Truchan. Journal of the American Chem. Society 70, p. 2910-2911, September 1948.

It was found that $CF_3CH_2CH_2Cl$ reacts in ether solution with magnesium to give the Grignard reagent $CF_3CH_2CH_2MgCl$. Anhydrous conditions must prevail. This Grignard reagent containing fluorine was converted by the standard reactions to $CF_3CH_2CH_3$, $CF_3CH_2CH_2OH$, and $CF_3CH_2CH_2CO_2H$. The γ,γ,γ-trifluorobutyric acid ($CF_3CH_2CH_2CO_2H$) is a new compound. It is a white solid (melting point 33.2°C, boiling point 166.6°C) and has an odor similar to that of butyric acid.

1590 The Moment of Inertia of CF_3CH_3, by Walter F. Edgell and Arthur Roberts. Journal of Chemical Physics 16, p. 1002, October 1948. (Letter to the editor)

As an initial step in determining bond distances and angle in CF_3CH_3, a preliminary study of the microwave spectrum near 1.5 cm wavelength was made. A standard 1.25 cm wave guide section was used as a Hughes-Wilson (Physical Review 71, p. 562, 1947) Stark effect spectrometer for the absorption cell. The two lines found yield values of $I_B = 161.80 \pm 0.07 \times 10^{-40}$ g cm^2 and $I_B = 162.04 \pm 0.07 \times 10^{-40}$ g cm^2 for the ground state and the unidentified excited state, respectively, when the moment of inertia perpendicular to the three-fold axis is calculated. Isotopic molecules will be prepared so that bond distances may be determined.

1591 The Synthesis of Fluorocarbons, by R. D. Fowler and Clifford E. Weber. Paper presented before the Divisions of Petroleum Chemistry and Gas and Fuel Chemistry, American Chemical Society, St. Louis, September 6-10, 1948. Abstract in Oil and Gas Journal 47, No. 19, p. 83, September 9, 1948.

In late 1941 and early 1942 the cobalt trifluoride method for the introduction of fluorine into hydrocarbons was developed by the author and his co-workers at Johns Hopkins University. This method consists in the passage of hydrocarbon vapor over a bed of cobalt trifluoride maintained at a temperature of 150° to 400°C. Complete replacement of hydrogen by fluorine occurs with yields that are generally very good, being as high in many instances as 96% of theoretical. Some of the apparatus involved is described, and typical products, such as perfluoro-n-heptane, perfluorodimethylcyclohexane, and perfluoro oils, are discussed in detail. Various physical and chemical properties such as boiling and melting points, refractive index, and chemical reactivity are discussed. The direct replacement

FLUOROCARBONS (Continued)

of hydrogen by fluorine, using elementary fluorine, which was successfully worked out by Von Grosse and Cady and resulted in good yields, is discussed. The possibilities inherent in more roundabout methods involving condensation reactions, such as those worked out by Miller, are also discussed.

1592 Ultrasonic Velocity in Some Liquid Fluorocarbons, by R. T. Lagemann, W. E. Woolf, J. S. Evans, and N. Underwood. Journal of the American Chemical Society 70, p. 2994-2996, September 1948. (See also MDDC-1592)

Using an ultrasonic interferometer described by McMillan and Lagemann (Journal of the Acoustical Society of America 19, p. 956, 1947) ultrasonic velocities were measured in four samples of fluorolube oils, three heavily fluorinated cyclohexane derivatives, hexadecafluoroheptane, and thirteen chlorotrifluoroethylene polymers ranging in molecular weight from 525 to 948. Tables are shown giving density, index of refraction, molecular weights, viscosity, and velocity of sound. Extremely low values of ultrasonic velocity were found. It was seen that the velocity is approximately a linear function of the temperature of the substances.

GEOPHYSICS

1593 Argon 40 in Potassium Minerals, by L. T. Aldrich and Alfred O. Nier. Physical Review 74, p. 876-877, October 15, 1948.

An investigation has been made of the isotopic composition of the argon from four potassium minerals using a high sensitivity mass spectrometer. The data have been interpreted using von Weizsacker's suggestion (Physikalische Zeitschrift 38, p. 623, 1937) that the abnormally high abundance of A^{40} in argon might be explained by assuming that K^{40} not only decays to Ca^{40} through beta emission but also to A^{40} through K-capture. In each case a high A^{40}/A^{36} ratio compared to that of atmospheric argon is observed showing that K^{40} decays to both Ca^{40} and A^{40}. From the absolute amounts of radiogenic A^{40} and K^{40} in the minerals a lower limit on the branching ratio of K-capture to beta emission can be made. Tabulated data for the minerals orthoclase, microcline, sylvite, and langbeinite are given. The branching ratios were computed using three different values for the half-life $K^{40} \longrightarrow Ca^{40}$ which have appeared in the literature. There is reasonable agreement among the values of the branching ratios obtained except for sylvite. In the case of the latter the low value obtained might be due to leakage of argon. If the half-life, 7×10^8 years, is assumed for $K^{40} \longrightarrow Ca^{40}$, λ_K/λ_β must be at least 0.02. The possibility of using this method for measuring geological age is suggested.

1594 Evidence of Geological Age against Decay of Tin-115 to Indium-115 by Electron Capture, by L. H. Ahrens. Nature 162, p. 413-414, September 11, 1948. (Letter to the editors)

The author attempts to utilize geochemical evidence for establishing whether significant decay of tin-115 by electron capture decay has taken place or not. A spectrochemical analysis was made of a specimen of cassiterite from pegmatite (age: $2{,}100 \times 10^6$ years). Only a doubtful trace of indium was detected.

The conclusions drawn are as follows: (1) The abundance of indium-115 (95.5 per cent) in natural indium is not due to electron capture decay of Sn^{115} during earth periods. (2) The presence of traces of indium in many tin minerals is not due to decay of tin-115. (3) Should tin-115 have decayed very feebly to indium-115, the rate of decay is extremely slow and the half-life of tin(Sn^{115}) is equal to or greater than 5.0×10^{12} years.

GEOPHYSICS (Continued)

1595 Natural Variations in the Isotopic Content of Boron and its Chemical Atomic Weight, by H. G. Thode, J. Macnamara, F. P. Lossing, and C. B. Collins. Journal of the American Chemical Society 70, p. 3008-3011, September 1948.

In order to determine the variation in the abundances of the boron isotopes, nine samples of boric acid (eight of known origin), from boron minerals obtained from widely separated geological deposits, were investigated. The samples were converted to boron trifluoride gas and the ratio B^{11}/B^{10} determined with a mass spectrometer. The ratios were determined with a precision of $\pm 0.1\%$ and an absolute accuracy of $\pm 0.5\%$ or better. Mass spectrograms of BF_2^+ and B^+ currents are given, as are tables of ratios obtained with different instruments under different conditions. The ratio varies from 4.27 to 4.42 and corresponding atomic weights have been calculated.

1596 Radioactivity and Mineral Composition of Soil, by P. J. Hoogteijling and G. J. Sizoo. Physica 14, p. 357, August 1948.

The data taken on sedimentary sands indicate that the radioactive elements are concentrated in the heavy mineral fraction, being chiefly bound to the zircon mineral. Tabulated activities are recorded for various zircon mineral contents and the zircon activity is compared with that of equivalent weights of the other heavy fractions of sands. Although no relationship between the radioactivity and the zircon content was found for clays, a correlation between radioactivity and potassium content was made. However, the potassium radiation accounted for only a small fraction of the activity of the clays studied. Tabulated data for various clay minerals are shown. No evidence for a concentration of the radioactive elements in any one of the clay minerals was found. It is concluded that during the chemical transformation of the original minerals into the clay minerals the radioactive elements are at least partially free and spread over the whole material by adsorption to the surface of the precipitating particles. 7 tables and 15 references.

HEALTH PROTECTION

1597 Tolerance Concentration of Radioactive Gases in Air, by G. Failla. AECD-2362 (CH - 1347; A - 1897), November 1942, decl. October 28, 1948. 11 p. Document for sale by AEC.

It is assumed that cancer of the lung may be produced by breathing air containing low concentrations of radioactive gas over a period of years. Experience in radiology has shown that exposure of the entire body to x-or gamma rays at the rate of 0.1 r per 8 hour day for a number of years causes no detectable changes in the blood counts of workers or in their general health. There is no indication that cancer of the lung may be produced by continued exposure of the body to this intensity of x- or gamma radiation. From this it is concluded that ionization of lung tissue at the rate corresponding to 0.1 r per 8 hour day does not cause cancer.

Cancer of the lung, as it occurs spontaneously in man, is practically always of the type that originates in epithelial tissues, and particularly in the lining of the bronchus. This is also true in the case of the lung cancers found in radium ore miners. Therefore, it would seem that radiation is most likely to produce cancer when the damage occurs in the epithelial lining of the air cavities of the lungs. It is apparent that the lining of the larger air cavities will be ionized to a greater degree than that of the smaller ones by short range radiation emitted by a radioactive gas uniformly distributed in the air within the cavities. Accordingly, the criterion of safety should be based on the ionization produced in the epithelial lining of the large air passages in the lung. A discussion is included of these factors and others that must be considered in determining the tolerance concentration of radioactive gases in air.

HEALTH PROTECTION (Continued)

1598 Problems Relative to Possible Physiological Effects Caused by Radiation, by Fred A. Bryan. Industrial Medicine 17, p. 367-371, October 1948.

Some of the problems occurring in the use and manufacture of radioactive materials are discussed from the viewpoints of possibility of exposure, the physiological effects on personnel resulting from exposure, and the maintenance of safe practices and good health in personnel. The greatest hazard of all can be the lack of knowledge concerning the physiological and toxicological effects of radioactive materials by the people using them. It is pointed out, however, that if all safety procedures are well worked out and diligently applied, use of atomic energy or its by-products is as safe as any other type of manufacturing.

1599 What Every Medical Officer Should Know About the Atomic Bomb. Part VIII. Public Health Aspects of Atomic Explosion. Bulletin of the U. S. Army Medical Department 8, p. 431-433, June 1948.

In the event of an atomic explosion the medical officer will be called on to assess the hazard and to advise accordingly. The advice of not only the physicist but also the meteorologist, geologist, and oceanographer will be needed. Precautions to be taken with food and water in a contaminated area are given. The importance of a decontamination center for area evacuation and efficient monitoring are emphasized.

INSTRUMENTS

1600 Physical Characteristics of a Sonic Interferometer, by N. Underwood, T. V. Blosser, and R. R. Feezel. AECD-2354 (K-263), August 24, 1948, decl. October 20, 1948. 35 p. For publication in a journal of the American Institute of Physics.

An abstract of this document was assigned the number MDDC-1797. The abstract has been listed in Abstracts of Declassified Documents 2, p. 235. April 15, 1948.

1601 An Investigation of the Properties of High-Valued Resistors and Methods of Reducing Surface Leakage, by Nancy F. Wood. AECD-2355 (CP-1223; A-1801), January 3, 1944, decl. October 21, 1948. 11 p. Informal disposition. Document for sale by AEC.

Resistors are needed which will remain constant in value over a period of months with varying conditions of temperature and humidity. Victoreen resistors of the order of 10^8 to 10^{11} ohms were tested for these characteristics as well as for changes due to continuous current and for polarization. Changes in value due to humidity in resistors of 10^{12} ohms or less apparently can be eliminated by cleaning, baking for several hours at 120°C, and varnishing with G. E. Varnish No. 9978. When varnished in this manner, Victoreen resistors are very satisfactory for use in D. C. amplifiers.

1602 Notes on Amplifier Design, by Yardley Beers. Brookhaven National Laboratory Electronics and Instrumentation Division Report BNL-I-6, n.d., 34 p.

These notes are based on a series of informal lectures. Topics discussed are the origins of noise in amplifiers, the concept of noise figure and its measurement, and some aspects of the design of amplifier input circuits.

1603 Stabilized High Voltage Supply, by W. A. Holmes. MIT Radiation Laboratory Report 565 (Office of Scientific Research and Development Contract), May 19, 1944. 13 p. (NP-27)

An audio-frequency generator is described which uses a 6V6 Hartley oscillator with the primary of an iron core transformer as the tank circuit. The secondary of the transformer provides a voltage which when rectified and filtered gives either 4 or 5 kv for output currents up to one-half milliampere.

INSTRUMENTS (Continued)

The oscillator requires 18 to 23 milliamperes at 300 volts dc. The 5 kv output will decrease 150 volts when the output current is increased 0.4 milliampere. The space required for this supply is 15" x 7" x 9" and the total weight is approximately 15 1/2 pounds. Operational tests, with satisfactory operation at 40,000 feet, after 24 hours at 95% humidity at 50°C, and after 500 hours of life test, indicate the design of this supply can meet service requirements.

1604 Electron Lenses of Hyperbolic Field Structure. Part 1, by Reinhold Rüdenberg. Journal of the Franklin Institute 246, p. 311-339, October 1948.

From the conditions of focus formation and Laplace's equation, a hyperbolic field structure is derived which permits a rigorous mathematical description and an explicit determination of electron trajectories of any amplitude. Various possible electron paths are formulated and charts are given for the most outstanding solutions, namely for symmetrical electron lenses and mirrors.

The focal properties of such field formations are derived and the results condensed to closed formulations and plots easy to survey. Uniform rays of parallel incidence do not suffer any aberration within the volume of this field. The performance of the focal length, the principal planes, and the back focus are discussed in detail, the latter being of great significance with respect to perfect image formation at high magnification. For thin lenses an approximation leads to a concise formulation which is in accord with published experiments. 8 diagrams and 14 graphs.

1605 Maxwell's "Fish Eye" as an Ideal Electron Lens, by Walter Glaser. Nature 162, p. 455-456, September 18, 1948.

The possibility of constructing an ideal electron lens, analogous to the "fish-eye" of Maxwell which furnishes perfect optical image formation, is demonstrated mathematically. To eliminate technical difficulties, the discussion is limited to plane image formation by an electron lens consisting of a set of axially symmetrical metallic electrodes which would produce the necessary potential distribution in the plane $z = z_0$, perpendicular to the axis. The surfaces of the potential function for various constant values are shown on a graph; these may be used to calculate the shape of the electrodes. It is suggested that by combining a uniform magnetic field with the electric field a cylindrical lens could be obtained which would be especially useful for a velocity spectrometer or in mass-spectrography. A further investigation of related potentials which might be of value in improving the stability of the electron trajectories will be given shortly in Acta Physica Austriaca.

ISOTOPES SEPARATION

1606 Isotope Separation, by Karl Cohen. MIT Nuclear Sciences and Engineering Seminars XXXVI and XXXVII, March 4 and 11, 1947. 24 p. (NP-162) (See also Nuclear Science Abstract No. I-475)

A theory of isotope separation is developed with binary mixtures. Generally speaking sufficient purity of product will not be attained in a single apparatus; it is necessary that a cascade arrangement be used. In any separation scheme there are two factors to be considered: the separative element itself, and the cascade; the cascade problem becomes more and more important as the enrichment per element decreases.

1607 Concentration of He^3 by Thermal Diffusion, by B. B. McInteer, L. T. Aldrich, and Alfred O. Nier. Physical Review 74, p. 946-949, October 15, 1948.

A thermal diffusion plant for the enrichment of He^3 has been constructed consisting of cylindrical columns followed by a hot wire column. In the case of the cylindrical columns excellent agreement with the theory of Jones and Furry (Reviews of Modern Physics 18, p. 151, 1946) has been obtained. For the hot wire column, discrepancies exist between the observed performance and that predicted by theory. Under continuous operating conditions it was possible to produce 14 standard cc of helium per day in which the He^3/He^4 ratio was 0.0021. Well helium was the source of the gas and

ISOTOPES SEPARATION (Continued)

16.6 kw of power were used. A schematic diagram of the flow system for the thermal diffusion plant is shown along with tabulated data on the dimensions and operating details. The experimental determinations of the constants in the expressions derived by Jones and Furry are also given in tabular form.

1608 On the Movement of Foreign Particles in Helium II, by L. Landau and I. Pomeranchuk. Doklady Adademii Nauk SSSR 59, p. 669-670, February 1, 1948. (In Russian)

J. Frank (Physical Review 70, p. 561, 1946) has suggested a method of enrichment of the isotope He^3, present in very small quantities in helium, on the theory that He^3 can have no superfluid properties and cannot therefore share in the superfluid movements of helium II. Daunt et al. (Physical Review 72, p. 502, 1947) have confirmed experimentally the possibilities of the method. The present author questions the theoretical explanation given by the previous writers and shows that any atoms, whether superfluid or not, when present in small quantities in He II, cannot accompany the latter in its superfluid movement.

MASS SPECTRA

1609 An Ion "Velocitron", by A. E. Cameron and D. F. Eggers, Jr. Review of Scientific Instruments 19, p. 605-607, September 1948. (See also MDDC-1641)

An instrument for viewing a mass spectrum which changes rapidly as a function of time is described. The separation of the individual ion peaks is accomplished without the use of a magnetic field by projecting ion pulses of known energy down a long evacuated drift tube, the velocity being inversely proportional to the square root of the mass. A block diagram is shown. The time interval between the arrival of pulses of ions of masses m_1 and m_2 will be directly proportional to the difference between their square roots, and will also vary directly with the length of the drift tube. The circuit for providing the necessary amplification, acceleration, and focusing is shown, and its operation described. Tabulated data of the calculated ion masses as a function of time interval are given; the calculated values are a fair approximation to the true values. Typical oscilloscope patterns obtained using Freon-12 and mercury vapor are shown.

1610 A Mass Spectrograph for Radioactive Isotopes, by Lloyd G. Lewis and Richard J. Hayden. Review of Scientific Instruments 19, p. 599-604, September 1948. (See also Nuclear Science Abstract I-1282)

A mass spectrograph for the separation of small quantities of radioactive isotopes is described. The instrument allows a direct determination of the mass numbers of radio-isotopes. It also permits the determination of the radiation characteristics of each of several radio-isotopes of an element where these have long half-lives, or have half-lives of the same order of magnitude. Slit counter and photographic plate techniques for analysis of deposits are described. An example, the analysis of a nine-month-old mixture of yttrium and rare earth fission activities, is described. The sample contained isotopes of Ce, Eu, Sm, and Pr.

1611 Mass Spectrometer Applied to Metals Analysis. Instruments 21, p. 856, September 1948.

Metal impurities have been traced at Westinghouse by means of a mass spectrometer. As little as one part of the impurity per million may be detected.

MASS SPECTRA (Continued)

1612 Spectroscopic Investigation of the Motion of Ions in a Plasma. Part II, by S. E. Frish and Yu. M. Kagan. Zhurnal Eksperimental 'noi i Teoreticheskoi Fiziki 18, p. 519-524, 1948. (In Russian)

Using a Fabry-Perot interferometer, the contours of spectral lines of ions and neutral atoms of argon are studied in their dependence on the strength of the discharge current and the gas pressure. Lines of ions have a wider breath than lines of neutral atoms. The lines of the ions are broader when examined across the capillary than along the capillary. From the half-width of the lines, ionic temperatures are calculated and compared with the temperatures of the atomic gas. As observed along the capillary, the dependence of the ionic temperatures on the pressure is analogous to the previously established displacement of ionic lines. The results obtained are interpreted from the point of view of the transport motion of ions in the electric field of the plasma.

MESONS (MESOTRONS)

1613 Divergence Difficulty and Mixed Meson Theory, by Gentaro Araki. Physical Review 74, p. 985-986, October 15, 1948. (Letter to the editor)

The author eliminates the divergence of the magnetic moment of nucleons as well as that of the two-nucleon potential in Yukawa's theory of mesons by assuming a pseudoscalar-pseudovector mixed theory of mesons. It is assumed that the interaction between pseudovector mesons and nucleons is the 6-vector coupling (g being its constant).

1614 On the Magnetic Moment of Nucleons According to the Pseudovector Meson Theory, by Gentaro Araki. Physical Review 74, p. 986, October 15, 1948. (Letter to the editor)

If the interaction between pseudovector mesons and nucleons is assumed to be a pseudovector coupling there again results, as in the assumption of a 6-vector coupling (Araki, Physical Review 74, p. 985, 1948), a negative surplus magnetic moment of the proton. The three kinds of pseudovector mesons are discussed, e.g., types in interaction with nucleons by (1) the 6-vector (antisymmetric tensor of the second rank) coupling, (2) the pseudovector coupling, and (3) both types of coupling. These are designated as "pvt," "pvv," and "pv," respectively. The vector and pseudoscalar mesons are designated as "v" and "ps," respectively. In considering a mixture of two fields, to eliminate divergences from the magnetic moment of nucleons and the two-nucleon potential, there are eight possible combinations. Upon considering all possible mixtures of two meson fields, the author concludes that only the mixtures ps and pvt, and pv and v result in the simultaneous elimination of divergences in both the two-nucleon potential and the magnetic moment.

1615 Observations on Slow Mesons of the Cosmic Radiation, by U. Camerini, H. Muirhead, C. F. Powell, and D. M. Ritson. Nature 162, p. 433-438, September 18, 1948.

Observations have been made on the directions of motion of mesons recorded by photographic plates exposed to the cosmic radiation. Angular distribution data for the different kinds of mesons are given in several graphs and tables. Results indicate that the negative mesons (mass approximately 200 m_e) in the penetrating component of the cosmic radiation rarely, if ever, produce the disintegration of nuclei with the emission of heavy charged particles, even when captured by heavy atoms. In experiments made near the ground, in addition to the downward stream of the mesons described, there is an upward stream of similar particles with an intensity approximately half that of the downward component. These mesons are accompanied by σ- and π-mesons. The mean life-time of the heavy particles is estimated as $6 \pm 3 \times 10^{-9}$ sec by comparing the relative numbers of the different meson types observed.

MESONS (MESOTRONS) (Continued)

1616 On the Existence of Particles Heavier than Mesotrons, by S. Ya. Nikitin. Zhurnal Eksperimental 'noi i Teoreticheskoi Fiziki 18, p. 577-602, July 1948. (In Russian)

Methods for measurement of ionization properties of relativistic particles were applied to the study of the spectra of cosmic radiation at 3200 m altitude. The soft component contained 3 groups of particles which were found to produce 1.3, 1.8, and 2.7 times as much ionization as that produced by mesotrons. These data result in the following particle masses: (330-500), (700-1100), and (2000-3500) m_e. These particles numbered only about 0.15% of the number of mesotrons present.

1617 On the Momentum Distribution of the Decay Electrons from Negative Mesons, by H. Primakoff. Physical Review 74, p. 878-882, October 15, 1948.

The momentum distribution of decay electrons from negative mesons bound in K-orbits is calculated assuming a two-particle disintegration of the meson into an electron and a neutrino or neutretto. The resultant momentum distribution has a spread approximately equal to $Z/137p_e^{(0)}$, where $p_e^{(0)}$ is the momentum of the decay electron from a free and stationary meson. The effect of the meson's binding on its mean life for decay is also considered and a small decrease in the mean life, approximately equal to $(Z/137)^2 \times 100$ per cent, is found.

1618 On the Multiple Production of Mesons, by G. Wataghin. Physical Review 74, p. 975-976, October 15, 1948. (Letter to the editor)

Experimental data on the multiple production of mesons are discussed with reference to the author's previously proposed description of the multiple creation of mesons by high energy collisions of nucleons (Symposium on Cosmic Rays, Academia Brasileira de Ciencias 129, 1941; Physical Review 70, p. 787, 1946; Comptes Rendus 207, p. 358, 1938). From the experimental data it is deduced that: (a) the cross section for the meson production by a primary proton (or by a secondary nucleon) is $\sim 5 \times 10^{-25}$ cm^2 per air nucleus (4×10^{-26} cm^2 per nucleon), varying only slowly with the energy; (b) in every collision the incident particle loses a large fraction of its energy; (c) the multiple production of mesons is a fundamental characteristic of high energy collisions of two nucleons or two nuclei. The average multiplicity is given by the following rule: in the center of mass system, the mesons and the nucleons have, after the collision, kinetic energies $\sim \mu c^2 \sim 10^8$ ev. (d) The variation with atmospheric depth of the number of fast nucleons, producing the local penetrating showers, obeys an exponential (Physical Review 71, p. 453, 1947; George and Jason, Nature 161, p. 248, 1948; Tinlot, Physical Review 73, p. 1476, 1948). The coefficient of absorption "b" of a fast neutron and "b*," the average coefficient of production of fast secondary nucleons, have been determined from transition effect and saturation point measurements. A value of about 50 gm/cm^2 was obtained for b^{-1}, whereas b^{*-1} was about twice as large. This would seem to indicate that primary protons are rare at sea level, most of the fast nucleons being produced by cascades of nucleons and meson showers. From energy considerations the following expression is obtained relating "E_p," the primary energy (ev) of the moving nucleon, to the average multiplicity "n": $E_p = 2\ \mu c^2\ (an^2 + bn + d)$. The theoretical bases of the author's description of the processes are discussed. Typical data for nuclear mass numbers of 1 and 14 are given for n and E' (the average meson energy) as functions of E_p, for values of the latter ranging from 5.0×10^9 to 1.9×10^{17} ev. The close correlation between the author's theory and the observed values is noted. For E_p of the order of 10^{17} ev, multiplicities of 10^5 mesons and meson energies of 10^{12} ev are found to occur. Such energies would be sufficient to explain the penetration of mesons at great depths.

METALLURGY

1619 Bibliography on Titanium Its Production, Properties, and Uses (1900 -1946), by Charles S. Dumont. Columbus, Ohio, Batelle Memorial Institute, August 14, 1947. 185 p. (NP-231)

References are listed under the following headings: physical properties of titanium; the metallurgy and production of pure titanium; the production and uses of titanium alloys as addition agents, including references to the system Fe-Ti; smelting titaniferous ore; titanium as an alloying element in steel; titanium in cast iron; alloys of titanium and aluminum; titanium-copper alloys; production, uses, and physical properties of titanium carbides and nitrides; titanium containing nonferrous alloys other than aluminum and copper; equilibrium diagrams for various titanium alloy systems; geology, crystallography, mineralogy and occurrence of titanium-bearing minerals, including concentrating methods; chemical method for the analysis of titanium; photometric and spectral analysis of titanium; the uses of titanium and its compounds in chemical reactions; the chemistry of titanium and its compounds; the physical and chemical properties of titanium dioxide; the production of titanium dioxide; titanium dioxide pigments in paint, rubber, paper, and cosmetics; the use of titanium in enamels, glass, glazes, and ceramic bodies; spectral analysis of titanium in astronomy; titanium in plants and soils; titanium in medicine; general information concerning the production, economics, and uses of titanium; titanium compounds in the textile and leather industry; the titanium arc, including patents covering titanium-containing electrodes and filaments. Patent references are included under many of the headings.

1620 Metallic Titanium and Its Alloys, by R. S. Dean and B. Silks. Bureau of Mines Information Circular 7381, November 1946. 38 p.

The logical starting point for producing metallic Ti is either the dioxide or the chloride. The production of the metal, the preparation, properties, fabrication and powder metallurgy of ductile titanium, and titanium alloys are discussed. 256 references.

1621 The Production of Some Rare Metals and Their Compounds as Practiced by E. Merck Chemische Fabrik, Darmstadt, by Joseph S. Smatko. Office of Military Government for Germany (US) FIAT Final Report No. 783, February 21, 1946. 13 p. (NP-253)

Small quantities of both crystalline and amorphous boron have been prepared. Small amounts of germanium and gallium metal and their compounds likewise were made. The preparation of caesium and rubidium involved larger apparatus than did the preparation of the others because the raw materials were low in Cs and Rb content. The processes used for all these are described in this report.

1622 The Properties of Zirconium, by R. I. Jaffee and I. E. Campbell. Columbus, Ohio, Battelle Memorial Institute, June 18, 1947. 27 p. (NP-266)

The discussion of properties and the listing of several typical uses of zirconium metal are presented as background data in considering possible new uses for the metal and its alloys. Data given in this report are mainly from measurements on zirconium made by thermal decomposition of zirconium iodide on hot wires.

Zirconium is a silver-gray, ductile metal, of excellent corrosion resistance at room temperature, and showing great chemical reactivity at elevated temperatures. Its tensile strength is not particularly outstanding; it is in between that of copper and nickel. It has remarkable ductility for a hexagonal metal. Its crystal structure is hexagonal close packed at ordinary temperatures and body-centered cubic at elevated temperatures. It is rather a poor conductor of heat and electricity, has a high melting point, and a relatively low density.

METALLURGY (Continued)

1623 Rare and Minor Metals, by Paul M. Tyler. Office of Military Government for Germany (US) Fiat Final Report No. 750, March 1, 1946. 20 p. (NP-254)

The purpose of this report is to afford a comprehensive picture of the rare metal industries in which Germany has always occupied a prominent position. It reviews previous reports briefly and adds new information on wartime developments and novel production methods. The elements discussed are: barium, bismuth, boron, caesium, rubidium, calcium, cerium, gallium, germanium, hafnium, indium, lanthanum, lithium, manganese, masurium, niobium (columbium), polonium, potassium, rhenium, selenium, sodium, strontium, tantalum, tellurium, thallium, thorium, titanium, uranium, and zirconium. Names of German producers of these elements are listed and data given on uses, prices, and quantities produced. 9 references.

1624 Study of Plastic Properties of Metals at Low Temperatures, Progress Report for Month of November 1947. Pittsburgh, Carnegie Institute of Technology (Office of Naval Research Contract), December 24, 1947. 3 p. (NP-346)

Further measurements have been made on the decrement changes produced in aluminum by oxide coatings. It had been reported previously that a film of thickness 2×10^{-4} cm increases the decrement by a factor of two. In these experiments both single and polycrystalline specimens were used. The following measurements were made: the samples were stripped of oxide; they were then glued to quartz crystals and their decrements were measured in vacuum; the system was then opened to air and the natural protective oxide film usually present on aluminum was allowed to form; the decrements were again measured in vacuum. Within the accuracy of the measurements no change was observed in the decrements of the specimens. Thus an increase in film thickness of 30 A changes the decrement by less than 10% of its original value. These experiments were performed on two single crystals and on two polycrystals. The estimated film thickness at the time of the first decrement readings was 10 A. The experiments are important because they prove that the camping increases as the thickness of the oxide film increases.

1625 Study of Plastic Properties of Metals at Low Temperatures, Progress Report for September 1947. Pittsburgh, Carnegie Institute of Technology (Office of Naval Research Contract), n.d. 4 p. (NP-347)

The decrements of four aluminium specimens were measured before the deposit of an oxide film, after the deposit of the film, and after the film had been removed chemically. The results are given in tabular form and the measurements given were made at a frequency of 38.5 kilocycles per second. The decrement is defined as the loss in energy of a freely vibrating system per cycle, divided by the total vibrational energy of the system.

The experiments tabulated show that the decrement of a metal specimen depends sensitively on surface conditions. It increases by about a factor of two when the sample is anodized. This additional damping cannot be due to a loading of the specimen because the oxide film weighs 5 milligrams while the specimen weighs several grams. Average errors in the decrement measurements was about 15%.

1626 Survey of Literature on the Metallurgy of Zirconium, by W. J. Kroll and A. W. Schlechten. Bureau of Mines Information Circular 7341, February 1946. 50 p. (NP-194)

This survey has been confined to those publications and patents that appear to be useful in the commercial development of malleable and nonmalleable zirconium. An attempt has been made to evaluate the effectiveness of suggestions made in the literature. The similarity of zirconium and beryllium is emphasized. The metallurgy of both metals is almost identical. Ideas used in the metallurgy of one of these metals are generally transferable to the other. Discussion is presented under the following headings: extraction of zirconium from ore; production of zirconium metal; zirconium

METALLURGY (Continued)

alloys and their properties; zirconium halides and their properties; other zirconium compounds (sulfides, phosphides and nitride); uses of zirconium and its compounds. 218 references.

1627 Alloys of Zirconium with Copper, Silver, and Gold (Die Legierungen des Zirkoniums mit Kupfer, Silber und Gold), by Ernst Raub and Max Engel. Zeitschrift für Metallkunde 39, p. 172-177, June 1948. (In German)

Equilibrium diagrams are given for Zr-Cu (up to 70% by weight Zr), Zr-Ag (up to 60% by weight Zr), and Zr-Au (up to 30% by weight Zr). These diagrams were obtained by means of thermoanalytical, microscopic, and x-ray methods. It was found that the alloys of zirconium resemble the noble metals in their properties more than the corresponding thorium alloys. Only the mixed crystals of the zirconium-gold series show promise of technical application. The particular advantage of this alloy is the fact that the zirconium greatly increases the hardness of the gold.

1628 Rare-Metal Metallurgy, by W. J. Kroll. Metal Industry 73, p. 263-265, October 1, 1948.

The author discusses the various methods for producing metals from their ores. He briefly discusses the reduction of the oxides of thorium, vanadium, and uranium with calcium in a pressure vessel.

MINERAL RESOURCES

1629 Source Materials for Nuclear Power, by Roland D. Parks. MIT Nuclear Sciences and Engineering Seminars XLIV and XLV, April 1 and 3, 1947. 27 p. (NP-163)

Seminar XLIV. The subject of source materials for nuclear power is approached from the economic point of view; the military aspects of fissionable materials are not considered. Emphasis is on uranium with reference to abundance, principal ores, reported occurrences, production rates, geologic processes, prewar size of mining activities, reserves, problem of estimating reserves, nuclear power compared with coal, low-grade sources of uranium and thorium. Maps are included which show the world centers of uranium and thorium production throughout the world and the general distribution of uranium and thorium production in the United States and Canada.

Seminar XLV. The economic and geologic picture is much clearer for thorium than for uranium. To date monazite has been the sole commercial source of thorium for all practical purposes. The following aspects of monazite sands are considered: principal occurrences, origin, types of deposits, mining and milling operations, production rates, mining limits, sources of monazite reserves. Other materials required for the production of nuclear energy include: boron, beryllium, bismuth, lead, graphite, helium, cadmium, mercury, sodium and potassium. Their availability and function in producing nuclear energy are briefly discussed.

1630 Thorium and Uranium Content of the Velence Mountains, Hungary, by A. Szalay. Nature 162, p. 454-455, September 18, 1948.

The following table gives the thorium and uranium content of acid eruptive rocks in mountains in the region of Lake Velence near the town of Székesfehérvár in Hungary:

Rock sample, place	g U/g rock	g Th/g rock
Granite from Velence	0.87×10^{-5}	4.2×10^{-5}
Granite from Nadap (rich in biotite)	0.86×10^{-5}	4.0×10^{-5}
Aplite from Nadap	0.80×10^{-5}	5.6×10^{-5}

The concentrations, although low, should be of value in the exact determination of the age of the rocks.

NEUTRONS

1631 Relative Cross Sections of Nuclear Reactions Induced by High Energy Neutrons in Light Elements, by William J. Knox. AECD-2340 (UCRL-175), September 9, 1948, decl. October 22, 1948. 14 p. For publication in a technical journal. (See also MDDC-1354)

Various light elements from carbon to sulfur were bombarded in the high energy (about 90 Mev) neutron beam of the 184-inch cyclotron and decay curves were taken on the resulting activities. Relative cross sections for certain reactions were obtained by analyzing the decay curves into component activities and comparing the yields with the activity induced in a carbon monitor bombarded in the same beam. All cross sections are given relative to the cross section for the $C^{12}(n,2n)C^{11}$ reaction which has been arbitrarily taken at 1.00. A table lists values for 16 reactions with a probable error of about $\pm 10\%$ and upper limits for six other reactions. An apparent regularity among these data is pointed out; the ratio of cross sections for reactions which differ by the ejection of an alpha particle or its equivalents is approximately three. This document is a revision and amplification of MDDC-1354.

1632 Stopping of Fission Fragments in Gases, by E. C. Campbell, W. M. Good, and W. A. Strauser. AECD-2341, n.d., decl. October 7, 1948. For presentation before the American Physical Society meeting in Chicago, November 26-27, 1948. (See also AECD-1932)

This document is an abstract; it is reproduced below in its entirety.

Studies of the range in air of those fission fragments of U-235 emitting delayed neutrons have been reported (Bulletin of the American Physical Society 23, p. 29, 1948; AECD-1932). Results have now been obtained by the same method for the absolute ranges, R_{22} and R_{55}, and straggling parameters, of the 22 and 55 second delayed neutron emitters in hydrogen, deuterium, helium, and argon. The influence on the straggling and range of the source-detector geometry and of the source thickness has been investigated. The observed fission fragment ranges are shorter in H_2 than in D_2 at the same pressure. In both gases the ranges are anomalously short, as observed by other workers. The relative straggling increases with the mass number of the stopping gas. These results are in accord with the theory of Bohr (Physical Review 59, p. 270, 1941), and show clearly the importance of nuclear collisions in the stopping of heavy particles. Results are given in the table.

	H_2	D_2	He	Air	A
R_{22} in mg/cm^2	.676	1.43	2.07	2.42	3.31
R_{22} in cm N.T.P.	7.60	8.00	11.6	1.87	1.86
R_{55} in mg/cm	.854	1.78	2.44	3.07	4.48
R_{55} in cm N.T.P.	9.60	9.95	13.7	2.38	2.52

1633 Spin Dependence of Slow Neutron Scattering by Deuterons, by E. Fermi and L. Marshall. AECD-2343 (ANL-HDY-533), July 14, 1948, decl. October 20, 1948. 10 p. For publication in Physical Review.

The cross section of deuterium gas at liquid air temperature for neutrons of average wave length, 5.43 A, is found to be 21.3×10^{-24} cm^2 per molecule. The cross section of deuterium atoms for neutrons of a few volts is found to be 3.44×10^{-24} cm^2 per atom. These two values are used to obtain information on the spin dependence of the neutron scattering by the deuteron. It is found that the two scattering lengths a_4 and a_2 corresponding to neutron spin parallel or antiparallel to the deuteron spin have the same sign but may differ in magnitude by as much as a factor 2.

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1634 Experiments on N-P Scattering with 90 and 40 Mev Neutrons, by J. Hadley, E. Kelley, C. Leith, E. Segre, C. Wiegand, and H. York. AECD-2344 (UCRL-166), n.d., decl. October 18, 1948. 36 p. For publication in Physical Review.

An investigation has been made of neutron-proton scattering at neutron energies of approximately 40 and 90 Mev. Both the total scattering cross section and the differential cross section as a function of the angle of scattering were measured. A plot of scattering angle against differential cross section summarizes all the data taken. 4 tables and 11 figures are included. This document is a revision and amplification of AECD-1825.

1635 A Study of the Interaction of Protons with Tritium, by R. F. Taschek and H. T. Gittings. AECD-2352 (LADC-570), August 31, 1948, decl. October 22, 1948. 19 p. For publication in Physical Review.

Preliminary measurements of the scattering cross section of tritium for protons and the reaction cross section for $T^3(p,n)He^3$ have been made. A method of analysis for hydrogen in tritium samples is described. The neutron yield of the reaction is high and will make it a useful source; the threshold is sharp and can be used as a point on the energy scale of nuclear physics. Figures show the laboratory and center of mass angular distributions at 1.59 Mev and 2.0 Mev and the 0° and 90° laboratory differential cross sections of the reaction as a function of proton energy. 10 references.

1636 Neutron Diffraction Studies, by C. G. Shull, E. O. Wollan, and M. C. Marney. AECD-2359, n.d., decl. September 29, 1948. 6 p. For publication in Physical Review. (See also MDDC-804, -822, -842, -869)

Samples of $Ni^{58}O$ and $Ni^{60}O$ were examined in a neutron diffraction spectrometer. Diffraction patterns in which neutron intensity is plotted against counter angle were obtained for Ni^{58}, Ni^{60}, and normal Ni. All scatter neutrons with positive phase and the scattering cross sections are widely different. From the measured intensities of the diffraction peaks, the coherent scattering cross sections for Ni^{58}, Ni^{60}, and elemental Ni have been determined as 27, 2, and 14 barns respectively. From transmission measurements on the nickel oxide samples, the total scattering cross sections for Ni^{58}, Ni^{60}, and elemental Ni were determined at 25, 3, and 17 barns respectively. The results are discussed briefly.

The scattering properties of Li^6 and Li^7 were also studied in the neutron diffraction spectrometer. Spectrometer traces for these samples are shown. The scattering phase for both Li^7 and elemental Li is negative and opposite to that of Cl. The coherent scattering cross sections for Li^7 and elemental Li have been calculated and from this the cross section of phase scattering for Li^6 has been evaluated. It is established that Li^6 scatters with a positive phase and with a calculated coherent scattering cross section of about 6 barns and that Li^7 scatters with a negative phase and with a cross section of 0.8 barns.

1637 Small Angle Scattering of Neutrons in Iron, by D. J. Hughes, M. T. Burgy, R. B. Heller, and J. W. Wallace. AECD-2363 (ANL-HDY-594), August 1948, decl. October 28, 1948. 15 p. For publication in Physical Review.

In connection with a series of experiments on the polarization of neutrons (D. J. Hughes et al, Physical Review 73, p. 1277, 1948), a new effect was found which complicated the polarization results. The fact that the small angle scattering disappears with moderate magnetizing fields was taken to mean that it is associated with the lining up of domains along the crystal axis (which takes place at low fields) and not with the rotation of the magnetic vector toward the applied field and away from the crystal axis (which takes place at high fields and which is necessary for neutron polarization). The cause of the scattering then, must lie in the domain structure of unmagnetized iron. According to the theory that the scattering is caused by multiple refraction it should be possible to fit the results to a Gaussian distribution whose width increases with the square root of d, the distribution. The

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comparison was made by assuming that each part of the direct beam was split into a Gaussian and that the sum of each Gaussian would represent the scattered beam. In this way a series of curves for the scattered distribution were calculated, each corresponding to a particular width, σ, for the Gaussian. It was found that the scattered distribution for each thickness was consistent with the shape of the calculated curves and that σ increased with the distribution. The experimental points for each block are shown with the calculated curves which best fit the results. Although the data are quite rough the calculated shape adequately accounts for the scattered distributions. The Gaussian width assumed for each block thickness is plotted as a function of the square root of distribution also. As the errors involved in fixing σ for each curve are quite large it can only be said that the variation of σ with the distribution is consistent with a $d^{1/2}$ relation and hence with the multiple refraction theory.

1638 Graphs Showing Neutron Cross Sections as Functions of A, Z, or N, by G. Haines and K. Way. AECD-2368 (ORNL-144), September 8, 1948, decl. November 2, 1948. 12 p. For possible publication. (See also AECD-2274)

The graphs were prepared from the neutron cross section data contained in AECD - 2274 (Tables of Neutron Cross Sections). A, Z, and N stand for atomic number, proton number, and neutron number respectively. Graphs are given showing activation cross sections for fast neutrons as a function of neutron number, gamma ray yields from bombardment with 2.4 Mev neutrons as a function of atomic number of the most abundant isotope of the element investigated, total neutron cross sections as a function of atomic number of most abundant isotope, and thermal neutron absorption cross section as a function of proton number.

1639 Contribution to the Theory of Resonance Scattering of Particles, by A. Akhiezer and I. Pomeranchuk. Zhurnal Eksperimental 'noi i Teoreticheskoi Fiziki 18, p. 603-608, July 1948. (In Russian)

It is known that the phenomenon of resonance scattering taking place at collisions between neutrons (or other particles) and atomic nuclei can be described by a resonance formula analogous to that describing the resonance interactions between light and matter. The formulas which have been given by various authors are, however, generally very complicated and not easily adaptable to a survey of the possible classes of the phenomenon. The present writers suggest a method for obtaining formulas of the cross sections of scattering, based on wave-mechanical considerations of a very general character. Their formulas show that only two general classes of scattering of slow particles by nuclei are possible: (1) those in which the amplitude is the resultant of the amplitudes of the resonance and the potential scatterings, and (2) those of the type of scattering occurring from collisions between slow neutrons and protons. The proposed method enables the natural introduction of the finite radius of action of nuclear forces, without special assumptions. Elastic and inelastic scatterings, cases of nuclear disintegration, and nuclear spin considerations are surveyed in succession.

1640 Measurement of Neutron Absorption Cross Sections with a Pile Oscillator, by J. I. Hoover, W. H. Jordan, C. D. Moak, L. Pardue, H. Pomerance, J. D. Strong, and E. O. Wollan. Physical Review 74, p. 864-870, October 15, 1948. (See MDDC-1664)

The measurement of thermal neutron cross sections using a high-sensitivity "pile oscillator" technique which has been developed for use with small samples is described. In this method, a neutron absorber is moved back and forth in a field of thermal neutrons such as that existing in a chain reactor. In the vicinity of the absorber there is a depression in the neutron flux and the motion of this depression past a nearby ion chamber produces an oscillating signal with amplitude proportional to the total neutron absorption cross section of the sample. The oscillating signal generated in the ion chamber is amplified, rectified, and fed to an integrating circuit. The pile oscillator mechanical assembly is shown; the graphite channel and ionization chamber are enlarged to show details. A diagram of the amplifier and integrator circuit is also given along with curves showing the wave forms

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of the voltage from the amplifier for one complete stroke of the sample past the ionization chamber for cadmium and graphite. The absorption cross section of an unknown sample is determined by comparing the charge accumulated in the integrating circuit with that produced by a standard gold absorber. The instrument will detect a total absorption cross section of about 10^{-3} cm^2 and hence it is suitable for measuring cross sections of separated isotopes which are available only in small quantities. One of the major difficulties in making this instrument useful for absorption measurements has been the elimination of the effects of scattering by the sample. The galvanometer deflection for different amounts of gold is shown graphically as an indication that by proper phasing of the rectifying switch (so that signal integration occurs only during the proper interval) deflection because of a scatterer can be made very small. It was found that the signals caused by absorption and scattering are slightly out of phase with each other, and by properly phasing the rectifier, absorption cross sections which are no greater than 1% of the corresponding scattering cross sections can be measured. A number of thermal cross section measurements have been made with this instrument, most of which will be published separately. Tabulated data of the different determinations of the cross sections of indium and silver made on successive runs are given. The following thermal cross section are given: In, 191.2 barns; Ag^{107}, 29.9 barns; Ag^{109}, 83.7 barns. (One barn equals 10^{-24} cm^2 and the cross section of gold (0.025 ev) is 95 barns.) The value for the cross section of natural silver of 55.9 barns obtained using measurements on enriched isotopic mixtures (using the described method) is in close agreement with the 59.8 barns value for the measured cross section of natural silver. The small discrepancy between the values may be due to contamination of the natural silver sample.

1641 Neutron Diffraction, by A. Akhiezer and I. Pomeranchul. Zhurnal Eksperimental 'noi i Teoreticheskoi Fiziki 18, p. 475-478, 1948. (In Russian)

Formulas are derived for the index of refraction of alow neutrons for ordinary crystals and magnetized substances (ferromagnetics and paramagnetics). In the latter case, the index of refraction and also the angle of total reflection depend on the orientation of the spin of the neutrons with respect to the vector of magnetic induction. This circumstance may be employed for obtaining complete polarization of a beam of neutrons.

1642 Nonelastic Dispersion of Slow Neutrons in Ferromagnetics, by G. Avak'yants. Zhurnal Eksperimental 'noi i Teoretichskoi Fiziki 18, p. 444-448, 1948. (In Russian)

Nonelastic scattering of slow neutrons in ferromagnetic materials at low temperatures are considered for those cases in which the scattering is conditioned by the excitation and the absorption of the spin waves by the neutrons.

1643 On the Measurement of Uranium Concentration on Impregnated Ilford D_1 Plates and the Determination of Effective Fission Cross Sections (Sur la Mesure de la Concentration en Uranium des Plaques Ilford D_1 Imprégnées et la Détermination de Sections Efficaces de Fission), by Charles Haenny and O. Rochat. Helvetica Physica Acta 21, p. 186-188, 1948. (In French)

The concentration of uranium-235, in an isotopic mixture enriched in uranium-235, may be determined by counting in a photographic emulsion the fission tracks produced by slow neutrons. The absolute value of the uranium concentration may be calculated by the formula

$$C_u = \frac{4 \times Tr}{N_{uI} \left[\sum_i \left(R_i - q \frac{a\,2}{a+1}\right) p_i\right] \cdot S \cdot \left(1 + \frac{R}{2\phi}\right)}$$

where N_{uI} = number of alphas emitted by a gram of uranium in 24 hours; R_i = the direction of the alpha ray in the emulsion (for the i^{th} alpha emitter); q = minimum direction observable; S = surface

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of the microscope field; ϕ = diameter of the microscopic field; a = (thickness before fixing/thickness after fixing; p_i = 1 for U I and U II and 0.04 for AcU. The optimum concentration is 0.30 g U/cc emulsion. The plates are insensitive to alpha rays, but fission tracks are easily identified. A determination of the effective cross section of a Ra-Be (50 millicurie) source was made, slowing down the neutrons in paraffin. The value obtained was 4.9×10^{-24} cm^2, with a possible 30% error.

NUCLEAR PHYSICS

1644 Third Semi-Annual Report. Swarthmore, Pennsylvania, Bartol Research Foundation of the Franklin Institute (Office of Naval Research Contract), March 15, 1948. 84 p. (NP-428)

The topics discussed in the body of the report include: Free balloon investigation of cosmic rays at very high altitudes; work with the Bartol electrostatic generator; high intensity ion sources; mass spectrography for separation of isotopes; coincidence measurements of radiations from Au isotopes; acceleration of electrons by resonant cavities. The following Geiger-Müller counter investigations are also discussed: Specific primary ionization measurements; polarization effects in ionization loss of fast charged particles; coincidence counting techniques for nuclear studies; Geiger-Müller counter development; photon counters. In the appendix are discussions of abnormality in cosmic ray absorption in lead at low latitudes, sea level latitude effects of cosmic radiation, the mass-energy relation, the effective path length through a vertical cosmic ray telescope, and polarization effects in the ionization loss of 1-Mev electrons in carbon. 20 references.

1645 Charts on Nuclear Physics. Pittsburgh, Pa., Westinghouse Research Laboratories, n.d., (With supplementary booklet of 36 p.)

Wall charts suitable for school room or laboratory.

NUCLEAR PHYSICS - METHODS OF MEASURING

1646 Relative Sensitivities of Some Organic Compounds for Scintillation Counters, by R. F. Taschek. AECD-2353 (LADC-571), August 31, 1948, decl. October 21, 1948. 9 p. For publication in Physical Review as a letter to the editor.

Ten organic scintillating materials have been compared for relative efficiency. Stilbene was found to be by far the best and several times better than anthracene. Other compounds investigated were phenanthrene, phenyl benzal glyoxalidone, triphenyl methane, fluorene, anthranilic acid, acenapthene, benzanthracene and diphenyl. No correlation with condensed ring systems has been found.

1647 Chang and Eng in Use, by W. H. Ray. AECD-2357, December 8, 1944, decl. December 1, 1947. 17 p. Document for sale by AEC.

"Chang and Eng" is the name of a twin chamber instrument designed in connection with a health physics program to measure the intensity of fast neutrons. A photograph of the apparatus setup, schematic diagrams of the instrument are given. The discussion includes a review of the principle of operation, difficulties encountered in using the instrument, electrometer and circuit, chambers and mountings, auxiliary units, operating steps and techniques, and calibration with a gamma standard.

1648 Model C4TIC Battery-Operated Alpha Hand Counter, by Herbert E. Meyer and Warren L. Hood. AECD-2364 (MLM-111), May 18, 1948, decl. October 28, 1948. 39 p. For possible publication.

The need for a small, battery-operated, semi-portable alpha radiation monitor was evident. In answer to the demand, an alpha hand counter was developed. Because of its simple construction, light weight, and conveniently accessible ionization chamber (under which suspected objects are checked),

NUCLEAR PHYSICS - METHODS OF MEASURING (Continued)

this instrument has become standard equipment throughout areas which are subject to the spread of alpha contamination. The most recent design, the model C4TIC, is discussed as follows in this report: general description, circuit analysis, operation, calibration, maintenance, and construction drawings.

1649 The Use and Calibration of a 100% Geometry Ion Chamber, by J. W. Jones and R. T. Overman. AECD-2367 (MonC-399), March 20, 1948, decl. November 1, 1948. 25 p. Informal disposition. Document for sale by AEC.

A pressure gamma ion chamber with approximately 100% geometry has been calibrated for a wide range of gamma energies and source intensities. A graph of gamma efficiency relative to Co^{60} versus gamma energy has been experimentally determined from 0.4 to 2.6 Mev. The true ion currents (I_Y) differ from the observed ion current. (I_X) because of ion recombination. Up to currents of $I_Y = 1.5 \times 10^{-8}$ amps (150 rd Co) the relation is $I_Y = I_X + 0.63 \times 10^8 I_X^2 - 0.4 \times 10^{16} I_X^3$. The stability of the instrument and accuracy of the measurement is treated. Directions for use of the instrument are included.

1650 Electron and Nuclear Counter Tubes. New York, Columbia University Division of Government Aided Research, n.d. 8 p. (NP-424)

Tables are given listing manufacturer and operating characteristics of the following type of tubes: gamma-ray counting tubes, combinations beta and gamma Geiger counters, beta-ray Geiger counters, slow neutron Geiger counters, proportional counters, alpha-ray Geiger counters, and combination alpha- and beta-gamma ray counters.

1651 Coincidence Device of 10^{-8} - 10^{-9} Second Resolving Power, by Z. Bay and G. Papp. Review of Scientific Instruments 19, p. 565-567, September 1948.

A coincidence device for use in nuclear experimentation requiring high resolving power is described. The radiation detectors are secondary electron multiplier tubes of high resolving power which are connected to a variation of the Rossi-type coincidence circuit. The resolving time for coincidence appears to be of the order of 10^{-8} to 10^{-9} sec.

1652 The Determination of the Pulse Period of Electron Multiplier Tubes, by G. Papp. Review of Scientific Instruments 19, p. 568-569, September 1948.

Two independent methods of determining the pulse period of secondary electron multiplier tubes are described. One method consisted of feeding the pulses on capacitors with variable RC and observing the oscilloscope screen. The other method consisted of creating artificial coincidences Both of these methods give a pulse period of less than 5×10^{-9} sec.

1653 Efficiency of Luminescence Production by Beta Rays in Zinc Sulfide, by G. I. Born, N. Riehl, and K. G. Zimmer. Doklady Akademii Nauk SSSR 69, p. 1269-1272, March 1, 1948. (In Russian)

A study of the luminescence efficiency of beta rays, i.e., of the fraction of electronic energy converted into light, was made by comparing the intensity of radiation of β-radioactive (containing $UX_1 + UX_2$) zinc sulfide with that of α-radioactive (containing radiothorium) zinc sulfide. The absorbed energy was calculated in the usual way. The results show that the efficiency of β-rays is about half that of α-rays. It has been known that the luminescence efficiency of cathode rays is very low, varying from 0.1 to 0.01 of that of α-rays which are known to undergo an almost complete conversion into light. The conclusions reached point to the possibility of using the luminescence method in the study of the β-emitting artificial radioactive substances. The results obtained confirm the theoretical picture of the luminescence phenomena given by Fano (Physical Review 58, p. 544, 1940).

NUCLEAR PHYSICS - METHODS OF MEASURING (Continued)

1654 Gamma-Ray Studies, by J. L. Lawson. General Electric Review 51, No. 10, p. 47-50, October 1948.

Techniques for determining the spectral distribution of intensity of gamma rays are discussed in general and a new type of gamma-ray spectrum analyzer, designed and constructed in the Research Laboratory of the General Electric Co., is described in detail. The analyzer consists of a series of Geiger counters suitably arranged about the inner periphery of a large vacuum chamber. These are used to detect the electron-positron pairs produced by gamma rays bombarding a thin target. A schematic diagram and a photograph of the analyzer are shown.

1655 On the Life of Self-Quenching Counters, by S. S. Friedland. Physical Review 74, p. 898-901, October 15, 1948.

The life of self-quenching counters has been studied using a Geiger-Mŭller counter filled with argon and ethyl acetate. This counter was connected to a mass spectrometer, and spectra were obtained after predetermined numbers of counts. Results showed that factors influencing the life of the counter were the disappearance of the quenching vapor and the formation of non-quenching vapors. An argon-methane counter, studied by the same method, showed that contamination of the insides of the counter, by the dissociation products, limited its life. This process occurred before any appreciable fraction of the methane was consumed. The linear relationship between peak height and the number of counts is shown graphically for several masses, and tabulated data are given for the peak heights before and after use in a methane-argon counter.

1656 A Study of the Deterioration of Methane-Filled Geiger-Mŭller Counters, by Earle C. Farmer and Sanborn C. Brown. Physical Review 74, p. 902-905, October 15, 1948.

The changes in the characteristics of methane-filled Geiger-Mŭller counters were studied as a function of counter life. Curves showing counting rate, build-up of hydrogen gas and operating characteristics as a function of counter age are shown. It was found that the counters had a useful life of between 10^7 and 10^8 counts. Mass-spectroscopic analysis of the gas during the life of the counter showed the major decomposition products in the gaseous phase to be hydrogen, ethane, ethylene, and acetylene. A table summarizing the mass-spectroscopic data is given. These changes in gas composition did not account for the counter deterioration. However, the heavy hydrocarbon products deposited on the electrodes resulted in counter failure.

1657 Technique for Observing Nuclear Disintegrations and Scattering in Small Gas Volumes, by R. F. Taschek. Review of Scientific Instruments 19, p. 591-594, September 1948. (See also MDDC-1633)

A scattering chamber of small gas volume is described and its uses as a neutron source are discussed. The non-planar scattering chamber side assembly view is shown. Curves of the observation angles as a function of the 45° ground joint, and of the slit rotation angle as a function of primary rotation angle, are shown. The differential pulse height curve showing deuterons scattered from deuterium and He^3 particles arising from D (d,n)He^3, both at 45° and 1.5 Mev deuteron energy, is given.

NUCLEAR PROPERTIES

1658 Quadrupole Moments of Heavy Nuclei, by F. I. Kligman. Zhurnal Eksperimental 'noi i Teoretichskoi Fiziki 18, p. 346-351, 1948. (In Russian)

It is shown that the drop model of the nucleus which considers all forms of nuclear energy, including non-central interactions, gives the possibility of obtaining the correct order of magnitude of positive quadrupole moments occurring in a large number of nuclei. A small number of nuclei with negative quadrupole moments cannot be fitted into the general scheme with any degree of assurance.

NUCLEAR TRANSFORMATION

1659 The Reverse Oppenheimer-Phillips Process, by A. Galanin. Zhurnal Eksperimental 'noi i Teoretichkoi Fiziki 18, p. 559-561, 1948. (In Russian)

The reaction A^m (He^3, He^4) A^{m-1} for a heavy atom is considered as a reverse Oppenheimer-Phillips process. It is shown that the probability of such a process for energies of the He^3 of several Mev is very small.

PARTICLE ACCELERATORS

1660 The Design and Construction of a 92″ Cyclotron; Research on the Measurement of the Physical Properties of the Mesotron; Research on the Properties of Nuclear Radiations by Deflection Methods. Harvard University Nuclear Laboratory Progress Report (Office of Naval Research Contract), September 1 - November 15, 1947. 45p. (NP-107)

The report describes and discusses the following: the cyclotron magnet, vacuum chamber, the oscillator, control circuits, shielding, and cooling devices; a thermal He^3 diffusion column; improvement of the focus and resolving power in magnetic spectrometers; the paucity of positive particles from P^{32}; silver chloride used as an ionization detector for cosmic rays; and cosmic ray and meson investigations in progress.

1661 Design of Cyclotron Magnets, by Martyn H. Foss. Carnegie Institute of Technology Department of Physics Technical Report No. 1 (Office of Naval Research Contract), June 27, 1948. 154p. (NP-426)

The study of cyclotron magnet design presented in this report is directed towards the attaining of a large ratio of energy in the ion beam to cost of the magnet. The pole tips are treated in the first chapter. The equation for the scalar potential of a midplane field which decreases linearly with increasing radius is given. The second chapter is devoted to coil design. Small coils make a more convenient cyclotron and reduce the amount of steel required in the flux circuit. The arrangement of conductors and the cooling of such coils is studied. Equations are derived for the optimum dimensions of the coils. In the third chapter the pole base, yoke, and optimum field are discussed. An equation for the optimum flux density in the pole base is derived. In the fourth chapter, a null method for determining the ratio of two quantities of flux is described. Only one absolute field measurement need be made on a model magnet. The remaining measurements can be made by the null method with good accuracy. Two methods for using the data are discussed.

1662 Resume of Cyclotron Project, by T. Moreno. MIT Research Laboratory of Electronics Technical Report No. 50 (Army Signal Corps Contract), October 30, 1947. 20p. (NP-140)

The greater part of the work undertaken involved the construction and test of scale models of proposed r-f circuits for use with the cyclotron. These scale models took the form of cavity resonators which were constructed of sheet copper; the scale was one-fifth actual size. The frequencies at which the model cavities were tested were correspondingly five times as high as the operating frequencies of the full-scale cyclotron. Three cavities were constructed and tested for resonant frequency

PARTICLE ACCELERATORS (Continued)

as a function of added tuning capacity. Some measurements of Q were also made; and searches made for resonant frequencies near the correct frequency that resulted from other resonant modes in the cavity. Some attempts were made to build oscillators which drive the cavities in the desired modes of oscillation. Some model variable condensers for tuning the resonant circuit were constructed and tested for capacity and tuning range.

1663 300-Mev Non-Ferromagnetic Synchrotron, Quarterly Progress Report Number 6, Period Ending March 1, 1948. Schenectady, New York, General Electric Research Laboratory, September 1, 1948. 103p. (NP-430)

The synchrotron was designed initially to be operated at electron energies up to about 300 million volts. However, the main tank and coil structure are designed for possible future operation up to energies of perhaps one billion volts. The main accelerating chamber is being designed to satisfy known requirements for operation at the highest expected energy; these requirements include cooling for power dissipation, mechanical bracing for larger forces, etc. Furthermore, the power equipment now being constructed for operation at energies of 300 million volts is designed for extreme flexibility so that the optimum conditions can be found for high-energy operation. This flexibility includes provisions for a wide range of pulse-repetition rates, betatron and synchrotron pulse wave shapes, timing sequences, d-c biasing of various elements, etc. Discussion and descriptions include: general considerations of the design; accelerator-chamber components; supplementary synchrotron components; and collimation and shielding. The report also deals with methods and equipments for high-energy research. Specifically discussed in this section are cloud chambers, X-ray spectrum analysis, and radiation intensity meters.

1664 Design Study for a Ten-Bev Magnetic Accelerator, by W. M. Brobeck. Review of Scientific Instruments 19, p. 545-551, September 1948. (See also MDDC-1697)

A ten-billion volt proton synchrotron design, using injection from Van de Graaff generators and betatron starting to reduce the required oscillator frequency range, is described. Factors affecting the design of the iron core magnet, its power supply, and associated apparatus are discussed. The theoretical development of the principle of synchrotron magnetic particle acceleration (McMillan, Physical Review 68, p. 143, 1945; Veksler, Physical Review 69, p. 244, 1946) and the testing of this principle (Richardson et al., Physical Review 69, p. 669, 1946) have removed one of the limits to the energy obtainable with magnetic accelerators. Radiation loss varying inversely as the rest energy of the particle (McMillan, Physical Review 68, p. 144, 1945) is negligible for protons even at ten-billion electron volts. The maximum obtainable energy therefore appears to be limited only by engineering feasibility. In order to gain some information on these factors a preliminary design of a proton accelerator has been worked out for what is believed to be the largest machine that could be made in the near future without departing from the techniques used on machines at present in operation. Ten-billion electron volts, which is in the range of energy of some primary cosmic-ray particles and the requirements for proton pair formation, appears to be attainable within the above restriction.

1665 A Method of Increasing Betatron Yield, by G. D. Adams. Review of Scientific Instruments 19, p. 607-608, September 1948.

The orbit contractor, a device for increasing the betatron yield which has been used in conjunction with the 22-Mev betatron models, is described. It consists of a wire on each pole face, both above and below the equilibrium orbit, through which a rapidly rising current is started when the electrons are injected. The direction of the current is such as to retard the rate of rise of flux within the orbit, causing electrons outside the equilibrium orbit to be suddenly drawn in toward the equilibrium orbit. Increasing the current strength also damps the radial oscillations of the injected electrons by decreasing the radial variation in magnetic field strength. The basic circuit is shown and tabulated data illustrating the increased yield obtained with the contractor at various injected currents are given. The actual increase in yield depends on the condition of the betatron. Increases in

PARTICLE ACCELERATORS (Continued)

yield are seldom less than 30% and more frequently 100% on the Illinois betatron. The percent yield improvement due to the contractor is found to increase greatly with decreasing injected current. It is suggested that for this reason contractors may be applied to advantage in machines with small vacuum tube cross sections in which it is difficult to get much circulating beam current. Kerst's recent explanation of the trapping of electrons into stable orbits is related to the author's experimental results (Physical Review 74, p. 503, 1948).

PETROLEUM INDUSTRY

1666 Theory of the Neutronic Logging of Drilling Holes in Prospecting for Oil and Coal, by Yu P. Bulashevich. Izvestiya Akademii Nauk SSSR Seriya Geograficheskaya i Geofizicheskaya 12, p. 155-168, March-April 1948. (In Russian)

The author examines the theoretical bases of neutronic logging in prospecting for oil and coal. From experimentally known values of effective cross sections of scattering and absorption of slow neutrons by nuclei, "neutron constants" of certain rocks and minerals are calculated, by postulating additivity of atomic cross sections in molecules. The relative characteristics of different rocks are found to depend on the dimensions of the sounding instrument.

PHYSICS, GENERAL

1667 Breakdown of a Gas at Microwave Frequencies, by Melvin A. Herlin and Sanborn C. Brown. MIT Research Laboratory of Electronics Technical Report No. 60 (Army Signal Corps Contract), May 3, 1948. 10p. (NP-339)

An electric field of sufficiently high frequency applied to electrons in a gas may deliver energy to the electrons without imparting to them any continuous drift motion due to the field. The criterion for breakdown of a low-pressure gas at microwave frequencies is that ionization by collision of electrons with neutral gas molecules replace loss by diffusion to the walls of the discharge tube. The condition is mathematically expressed as a simple boundary value problem. The breakdown principle is applied to converting microwave breakdown measurements into measurements of ionization rates as a function of the electric field strength, pressure and frequency. A new ionization coefficient is introduced appropriate to the high-frequency discharge conditions, and its relation to the d-c Townsend coefficient is explained. The energy transfer from the electric field to the electrons at a given E/p is shown to be most efficient when the pressure is high enough or the frequency low enough to result in many collisions of electrons with gas molecules per cycle. This maximum efficiency is equal to the d-c energy transfer efficiency. When the pressure is lower or the frequency is higher, the electrons have an out-of-phase component motion and do not receive energy so efficiently; hence in this case lower ionization rates are experimentally observed.

1668 Electrical Breakdown of a Gas Between Coaxial Cylinders at Microwave Frequencies, by M. A. Herlin and S. C. Brown. MIT Research Laboratory of Electronics Technical Report No. 72 (Army Signal Corps Contract), June 14, 1948. 10p. (NP-416)

The criterion for breakdown of a low-pressure gas at microwave frequencies is that the ionization rate equal the diffusion rate for electrons. This principle is applied to compute the breakdown of air in coaxial cylinders by using previously reported high-frequency ionization coefficient data obtained from breakdown experiments between parallel plates. Agreement between computed and measured results at 9.6-cm wavelength supports the validity of the above criterion for breakdown. The method of computation is illustrative of the general problem of computing breakdown fields for tubes of arbitrary shape and field configuration by using ionization coefficient data obtained from uniform-field breakdown.

PHYSICS, GENERAL (Continued)

1669 The Electrical Conductivity of Silicon and Germanium, by F. Seitz. National Defense Research Committee Report D1-110 (University of Pennsylvania - Office of Scientific Research and Development Contract), November 3, 1942. 18p. (NP-248)

Silicon and germanium are both highly absorbing in the visible spectrum so that they might be expected to show intrinsic semi-conductivity at reasonably elevated temperatures. The experiments carried out and described in detail in the report show that this is the case. The experiments also show that the intrinsic part of the conduction usually is entirely negligible at room temperature, so that the electrical characteristics of interest for rectification purposes are determined by impurity agents.

1670 The Absorption of the Energy of High Frequency Currents by Ionized Gases (Sur l'Absorption d'Energie des Courants de Haute Fréquence par les Gaz Ionisés), by Vasile P. Mihu. Comptes Rendus 227, p.472-475, August 23, 1948. (In French)

The results of previous experiments on the absorption of the energy of high frequency currents by ionized gases are verified and extended, using hydrogen-filled tubes. The current in a resonant coil of an oscillating circuit will vary with that passing through a Geissler tube inside the coil (Ionescu and Mihul, Comptes Rendus 196, p.682, 1935; Mihu, Comptes Rendus 207, p.52, 1938). Using a thermocouple, data were obtained showing the relationship between energy variation in the resonating coil and the current in the tube. A curve obtained for $\lambda = 302$ cm, $p = 0.22$ mm Hg, is shown. Similar data were taken for wave lengths in the 240 cm to 594 cm range. Curves showing energy absorption as a function of pressure are given for wave lengths of 240 cm, 302 cm, and 594 cm, and the constant in the equation of the parabolic curves obtained is determined for these wave lengths. The maximum absorption is found to occur at a pressure of 0.14 mm of Hg for all frequencies. At pressures lower than 0.14 mm of Hg, a deviation from the parabolic curve is observed. The investigators plan to study these phenomena in other gases.

1671 Ion Recombination Coefficient for Coronal Discharge in Air, by V. I. Popkov. Doklady Akademii Nauk SSSR. 59 p. 61-64, January 1, 1948. (In Russian)

Coefficients of volume recombination were obtained by previous workers from measurements taken in an ionization chamber on ions generated by alpha or x-rays. These figures are applicable only to long lived ions (about 0.1 sec), since for smaller intervals the so called initial recombination prevails in the ionization chamber, making the determination of the volume recombination rather difficult. In certain discharges in air, as for instance in the coronal discharge, the recombining ions, moving in a field of high gradients, are considerably shorter lived, and it is possible to calculate the recombination coefficient on the basis of an experimental study of the field. In the case of a bipolar corona two streams of ions move in opposite directions between the electrodes. The lifetime of every recombining ion is equal to the time spent in moving the ion from one of the electrodes to the point of the field at which the recombination coefficient is to be determined. The growing difference in lifetime of the two recombining ions causes the coefficient to increase toward the two electrodes, from a minimum corresponding to a middle point. The obtained values of the recombination coefficient (maximum 2.16×10^{-6}, minimum 1.26×10^{-6}) show only small deviation from those given by authors using the ionization chamber method.

1672 Ionization of Atoms and Neutralization of Ions on the Surface of the Semi-Conductor Cathode, by N. D. Morgulis. Zhurnal Eksperimental 'noi i Teoretichskoi Fiziki 18, p. 567-572, 1948. (In Russian)

The ionization of atoms and the neutralization of ions on semi-conductor cathode surfaces was investigated as a continuation of previous work. The peculiarities of the phenomena associated with

PHYSICS, GENERAL (Continued)

such systems are shown and differentiated from those occurring on metallic surfaces. Approximate expressions for their probabilities are given and an explanation for some of the facts observed.

1673 On Methods for Studying Processes on Heterogeneous Surfaces, by V. I. Levin. Doklady Akademii Nauk SSSR 59, p. 269-272, January 11, 1948. (In Russian)

The recent advances in the understanding of the phenomena of adsorption and catalysis are due to the fact that adequate attention has been given to the heterogeneity of surfaces. The usual procedure is to express the heterogeneity of a surface, in regard to a certain property, as a distribution function of this property. The converse is of considerable interest, i.e., given experimentally the characteristics of the surface, to find the distribution function. Roginskii [Absorption and Catalysis on Heterogeneous Surfaces (in Russian), published by the Academy of Science, USSR, 1948] gave a method for an approximate solution of this problem, as regards the distribution function of the heats of adsorption, and the distribution function of the activation energies of activated adsorption. He was able, on the basis of the relations found, to construct a consistent theory of the processes on heterogeneous surfaces. However, his method is applicable only to cases satisfying certain conditions. Other writers have suggested methods free of these limitations and applied them to finding the distribution function of the heats of adsorption. The present author gives the solution of the problem with regard to the distribution function of the activation energies of activated adsorption by deducing it from the kinetic isotherm of adsorption.

PHYSICS, THEORETICAL

1674 Recent Developments in Relativistic Quantum Theory, by C. Moller. Lecture delivered at University of Bristol, Spring Term, 1946. 33p. (NP-422)

The lecture is a development of Heisenberg's theory. The energy and momentum of a free particle, the cross-section of any collision process with or without the creation and annihilation of particles, the discrete energy levels of atomic systems in closed stationary states, and the decay constants of radioactive systems may be calculated by means of the Schrodinger equation when the Hamiltonian function of the system is known. The collision cross-sections, however, are given more directly by the matrix elements of a certain unitary matrix S, which depends on the Hamiltonian in a rather complicated way. Recently Heisenberg has taken an important step towards the correct formulation of the new quantum theory by assuming that this characteristic matrix S or an Hermitian matrix, n, connected with S by the relation $S = e^{in}$ will, in the new theory, take over the role played by the Hamiltonian in quantum theory, i.e., in future the atomic systems should be defined by a knowledge of the matrices S or n.

1675 Analytic Behavior of Heisenberg's S-Matrix, by R. J. Eden. Physical Review 74, p. 982, October 15, 1948. (Letter to the editor)

The analytic behavior of Heisenberg's partial and complete S-matrices for the scattering of a photon on a hydrogen atom is discussed for both elastic and inelastic scattering. In order that a consistent picture be given by the complete S-matrix, the analytic continuation of matrix elements in the region where inelastic scattering is impossible must be interpreted. This results in the conclusion that in S-matrix theory a negative probability corresponds to a physically impossible process. A fuller account of these calculations will be published later.

1676 Decelerating Radiation During the Collision of Electrons, by E. M. Lifshitz. Zhurnal Eksperimental 'noi i Teoretichkoi Fiziki 18, p.562-565, 1948. (In Russian)

A calculation is made of the effective cross section for retarding radiation on collision of electrons in the non-relativistic quantum case ($c \gg v \gg e^2/h$, where v = velocity of electrons). The spectral and angular distributions of radiation are determined.

PHYSICS, THEORETICAL (Continued)

1677 The Determination of the Masses Necessary to Produce a Given Gravitational Field, by E. C. Bullard and R. I. B. Cooper. Proceedings of the Royal Society 194 A, p. 332-347, September 2, 1948.

Two methods are described for calculating the distribution of mass at a given depth that will produce a specified gravitational field. In one the observed field is extrapolated downwards by a finite difference procedure; in the other a solution is obtained in the form of an integral which can be evaluated numerically. Tables of the quantities necessary for the practical use of the method are provided, and real and artificial examples are given. The limit to the possible depth of the masses producing an anomaly is also discussed.

1678 The Double Aspect of the Maxwell Equations in the Quantum Theory of Radiation (Le Double Aspect des Equations de Maxwell dans la Théorie Quantique du Rayonnement), by Jean G. Valatin. Comptes Rendus 227, p. 177-179, July 19, 1948. (In French)

Maxwell's first order differential equations were interpreted as a wave equation of the photon state, assuming exact validity of the classical equations for the quantum fields.

$$\dot{x} = \frac{i}{h/2\pi}(\mathcal{H}x - x\mathcal{H}) = \left(\frac{\partial}{\partial x}x - x\frac{\partial}{\partial x}\right) c\sigma_x\epsilon = V_x;$$

$$\dot{y} = \frac{i}{h/2\pi}(\mathcal{H}y - y\mathcal{H}) = c\sigma_y\epsilon = V_y;$$

$$\dot{z} = \frac{i}{h/2\pi}(\mathcal{H}z - z\mathcal{H}) = c\sigma_z\epsilon = V_z$$

The velocity operators have the proper values $\pm c$, 0. The operator ϵ (± 1) characterizes circular polarization if limited to the positive spectrum of $\mathcal{H}$. A complex expression for the field vector is developed. The fact that the photon cannot be localized may be due to the coordinates not being even operators.

1679 Field Theory of Attracting Particles, by D. I. Blokhintsev. Zhurnal Eksperimental 'noi i Teoretichskoi Fiziki 18, p.566-574, 1948. (In Russian)

A relativistic invariant theory of the electromagnetic field is presented. It is based on the possibility of propagation of the interaction in small space-time regions with velocity greater than that of light.

1680 Interaction between Electron and Positron during Pair Production, by A. D. Sakharov. Zhurnal Eksperimental 'noi i Teoreticheskoi Fiziki 18, p. 631-635, July 1948. (In Russian)

In the calculation of the differential probability of pair production the interaction between components has never been taken into account. The effect of this interaction can only be significant at small values of the relative velocity, v, of the components in the final state. The interaction itself may therefore be regarded as the Coulomb force e^2/r. For processes of the first order, the author gives a correction factor, $T = 2\pi\epsilon/(1-e^{-2\epsilon\pi})$, where $\epsilon = e^2/v$. This result is then confirmed for processes of the second and higher orders. The interaction between components in the intermediate state is found to be insignificant. Finally, the spin and relativistic effects are discussed.

1681 Motion of an Electron in the Field of a Magnetic Pole, by Harish-Chandra. Physical Review 74, p. 883-887, October 15, 1948.

The motion of an electron in the field of a magnetic pole, previously considered by Dirac (Proceedings of the Royal Society 133, p. 60, 1931), is further investigated taking into account the spin of the electron which Dirac neglected. The author shows that in spite of the magnetic moment due to the spin, Dirac's result is still valid and the electron has no bound states.

PHYSICS, THEORETICAL (Continued)

1682 The Non-relativistic Wave Equation for Particles of Spin $h/4\pi$ in a General Nuclear Field (Sur l'Equation d'Ondes Non Relativiste des Corpuscles de Spin $h/r\pi$ dans un Champ Nucléaire Général), by Gérard Petiau. Comptes Rendus 227, p. 263-264, July 26, 1948. (In French)

A Dirac particle having a spin of $h/4\pi$, and characteristic mass m_0 is considered in its interaction with a general nuclear force field characterized by a scalar I_1, a vector U_0, $\underline{U}$, a second order antisymmetric tensor $\underline{P}$,$\underline{M}$, a pseudo-vector S_0, $\underline{S}$, and a pseudo-scalar I_2. A non-relativistic expression is obtained and the electromagnetic field and the fields of four kinds of mesons, i.e. scalar, vectorial, pseudo-scalar and pseudo-vectorial, are introduced. Equations are thus obtained for generalizing Pauli's equation for the electron. By neglecting a particular equation, Schrodinger's equation for a particle having a spin of $h/4\pi$ in interaction with a mixed nuclear field consisting of electromagnetic and mesonic fields is obtained. The equations derived by the author clearly illustrate the influence of the spin on nuclear diffusion phenomena.

1683 A Note on the Magnetic Moment of the Electron, by J. M. Luttinger. Physical Review 74, p. 893-898, October 15, 1948.

Recent experiments (Kusch and Foley, Physical Review 72, p. 256, 1947; 73, p. 412, 1948; Nafe and Nelson, Physical Review 73, p. 718, 1948) seem to require a modification in the g-factor of the electron. It has been suggested (Schwinger, Physical Review 73, p. 415, 1948; Bulletin of the American Physical Society 23, p. 15, April 1948) that the coupling between the electron and the radiation field is responsible, and Schwinger has calculated the effect on the basis of a general subtraction formalism for the infinities of quantum electrodynamics (as yet unpublished). The author shows that the change in magnetic moment may be derived very simply without any reference to an elaborate subtraction formalism by using the quantized formalism of the theory of holes [Wentzel, in Ein. in die Quant. Theorie der Wellenfelder (Franz Deuticke, Wien, 1943), p. 158-91] for the electron and quantum electrodynamics for the radiation field.

1684 On an Exact Solution of Dirac Electron in the Field of Electromagnetic Radiation, by N. D. Sengupta. Bulletin of the Calcutta Mathematical Society 39, p. 147-153, December 1947.

An exact solution of the Dirac equation of an electron in the field of a plane electromagnetic radiation is obtained. The solution is for monochromatic radiation and can be extended to the case where radiation is not monochromatic. With the help of this solution it is possible to study rigorously all problems relating to interaction of free electron and radiation. The general solution is:

$$\psi = \int \exp \frac{i}{h/2\pi} S. \left[1 + \frac{e}{2c} \frac{(A\,\sigma)\,(N\,\bar{\sigma})}{(pN)}\right] \psi_0\,(p)\,dp; \text{ and}$$

$$\phi = \int \exp \frac{i}{h/2\pi} S. \left[1 + \frac{e}{2c} \frac{(A\,\bar{\sigma})\,(N\,\sigma)}{(pN)}\right] \phi_0\,(p)\,dp.$$

1685 On the Scalar Mesostatic Field and its Gravitational Effects, by I. Z. Fisher. Zhurnal Eksperimental 'noi i Teoreticheskoi Fiziki 18, p. 636-640, July 1948. (In Russian)

The scalar mesostatic field of a point source and the space-time curvature determined by this field have been investigated. For a field with $\kappa = 0$ an exact solution of Einstein's equations is given. At small distances from the source the gravitational effects are strong enough to cause considerable changes in the behavior of the meson field. In particular, the total energy of the static field diverges logarithmically.

PHYSICS, THEORETICAL (Continued)

1686 On the Theory of the "Luminous" Electron, by D. Ivanenko and A. Sokolov. Doklady Akademii Nauk SSSR 59, p. 1551-1554, March 21, 1948. (In Russian)

This is a deduction of a general formula for the spectral distribution of the electromagnetic radiation of the "luminous" electron, i.e., the radiation due to radial acceleration of electrons in accelerators such as the betatron and synchrotron. The formula gives the radiation intensity W_n for the harmonic number n as a function of that number, the velocity of the electron, and the radius of its orbit in the accelerator.

1687 Phenomenological Quantum-Electrodynamics, by J. M. Jauch and K. M. Watson. Physical Review 74, p. 950-957, October 15, 1948.

The quantization of the pure radiation field in a uniformly moving refractive medium is carried through both in the Hamiltonian and in the symmetrical four-dimensional form. The total energy and momentum are diagonalized. Photons with negative energy are found to occur when the medium velocity is large enough.

1688 A Relativistic Cut-Off for Classical Electrodynamics, by R. P. Feynman. Physical Review 74, p. 939-946, October 15, 1948.

Previous attempts to devise a classical electrodynamics which would not contain the difficulty of infinite self-energy (which carries over into quantum electrodynamics) are discussed. The author describes a consistent classical theory which he believes can be quantized. Ordinarily it is assumed that interaction between charges occurs along light cones, that is, only where the four-dimensional interval $s^2 = t^2 - r^2$ is exactly zero. The modifications produced if substantial interaction is assumed to occur over a narrow range of s^2 around zero are discussed (Bopp, Annalen der Physik 42, p. 573, 1942). This has no practical effect on the interaction of charges which are distant from one another by several electron radii. The action of a charge on itself is finite and behaves as electromagnetic mass for accelerations which are not excessive. There also results a classical representation of the phenomena of pair production in sufficiently strong fields.

1689 Some Mathematical Methods in the Theory of the Scattering of Particles, by I. E. Tamm. Zhurnal Eksperimental 'noi i Teoretichskoi Fiziki 18, p. 337-345, 1948. (In Russian)

A variation method is presented for finding eigenfunctions of the continuous spectrum of the Schrodinger equation analogous to the Ritz method for the discrete spectrum. This method permits the calculation, by means of successive approximations, of the collision cross sections of particles. The scattering of particles by a central force field is considered in momentum space. The singular integral equation determining the scattering in this space is converted into an integral equation free from singularities. Both of the methods presented can be easily generalized to apply to a more general class of equations.

1690 Theory of Internal Conversion, by H. A. Meyer, Physical Review 74, p. 979, October 15, 1948. (Letter to the editor)

The internal conversion coefficient for a K-electron as a function of $\theta = mc^2/h\nu$, assuming a dipole transition, was computed. The curve thus obtained for an electron in an atom of atomic number 84 is compared with a curve of Hulme's results (Proceedings of the Royal Society 138, p. 643, 1932). For the highest energy considered there is a 30% discrepancy between the two curves. Quadrupole transitions are being computed.

1691 The Theory of the Point Electron, by A. A. Sokolov. Zhurnal Eksperimental 'noi i Teoretichskoi Fiziki 18, p. 280-284, 1948. (In Russian)

An investigation is made of a series of questions associated with the classical theory of motion of point electrons.

PHYSICS, THEORETICAL (Continued)

1692 Theory of the Nuclear Field and the Characteristic Energies of Elementary Particles (Sur la Théorie du Champ Nucléaire et les Energies Propres des Particules Elémentaires), by Robert Potier. Comptes Rendus 227, p. 464-466, August 23, 1948. (In French)

The author modifies the nuclear field theory of Moller and Rosenfeld (Kongelige Danske Videnskabernes Selskab 17, p. 8, 1940) by describing a method of eliminating the infinite energy of the nuclear particle-meson field. To eliminate dipolar type interactions between the nuclear particles, Møller and Rosenfeld assumed the interaction of two kinds of field particles of equal mass, i.e., vectorial and pseudo-scalar mesons, having spins of one and zero respectively. The dipole type interaction must be eliminated so that finite energy levels for the deuteron can exist. A disadvantage of this indicated by Bethe (Physical Review 57, p. 260 and 390, 1940) is the fact that the non-symmetric dipolar interaction term gives a good quantitative interpretation of the electric quadrupole moment of the deuteron which vanishes with it. The author assumes the existence of four types of mesons (not necessarily of equal mass), which he classified as scalar, vectorial, pseudo-scalar and pseudo-vectorial. An expression is obtained for the total static energy "H" of a system of nuclear particles. The conditions for which H takes a finite value are discussed. (H is identically zero if the masses of all four particles are equal.) If three of the masses are assumed very large in comparison with the fourth, a trough in the nuclear field exists, which is relativistically invariant and has a physical interpretation. It is shown that the existence of three kinds of mesons, i.e., vectorial, scalar and pseudo-vectorial, is indispensable to this theory. This results in three independent coupling constants, one of which may be omitted if the pseudo-scalar meson is neglected. The sign and order of magnitude of the dependent interactions of the postulated particles are in accord with experimental values. The possibility of using an analogous method to eliminate infinite energies from the electromagnetic field is suggested; if a very heavy scalar particle is assumed in addition to a photon of vanishing or zero mass, the effects of the former dwindle rapidly with increasing distance.

1693 Theory of the Propagation of Electromagnetic Waves in a Magnetically Active Medium, by V. L. Ginzburg. Zhurnal Eksperimental 'noi i Teoroticheskoi Fiziki 18, p.487-500, 1948. (In Russian)

This article is devoted to the development of the theory of the propagation of electromagnetic waves in a magnetically active medium (in an ionosphere, considering the influence of the earth's magnetic field). An approximate solution of the propagation equation is made in the region of the reflection of the wave from the layer and in the first part of the layer where geometrical optics is not valid. The effect of 'tripling' of the signal is examined for the approximation valid at small angles between the magnetic field and the direction of propagation. The problem of the effective field is refined, and an expression is obtained by means of the kinetic equation for the effective number of collisions with due consideration of a magnetic field.

1694 Wave Mechanics — Classical Mechanics Correspondance. Integral of the Second Order Independent of the Time. Principle of the Extreme. Formation of Operators of the Second Order (Mécanique Ondulatoire. Correspondance Mécanique Classique-Mécanique Ondulatoire. Intégrale du Deuxième Ordre Indépendante du Temps. Principe d'Extrémum. Formation des Opérateurs du Deuxième Ordre), by Robert Faure. Comptes Rendus 227, p.261-263, July 26, 1948. (In French)

The previous study (Comptes Rendus 224, p. 797, 1947) of the correspondance between the first integral operators of the second order and the quadratic first integrals in a particular case enabled the deduction of the form of the group of differential terms of the operator. The author studies the general case for the classic Hamiltonian H as a function of the first integral F. The classical equations are indicated and an expression for commutation to wave mechanical form is given. A series of partial differential equations are thus developed which are consistent and may be solved using the calculus of vari. ons. From these equations a theorem is deduced relating the integrals in the classical and the wave mechanical forms.

RADIATION SICKNESS

1695 Bone Marrow Implants in the Treatment of Radiation Sickness, by John M. Talbot, John E. Pickering, and Everett O. Richey. U. S. Air Force School of Aviation Medicine Quarterly Research Report, p. 17, July 1 to September 30, 1948.

Work on this project is just being initiated. The purpose of the experiment is to determine whether or not homogenous implants of healthy bone marrow will affect the course of events in acute radiation sickness in laboratory animals, with the ultimate aim of developing a method for treating acute radiation sickness in man.

1696 Radiation-Induced Hemorrhagic Disease in Chickens, by Frank J. Dixon. Proceedings of the Society for Experimental Biology and Medicine 68, p. 505-507, July-August 1948.

Young chicks were given repeated subcutaneous injections of P^{32} in order to produce severe radiation injury for a study of hemorrhagic disease resulting from radiation. The red blood cell, granulocyte, and platelet counts and blood coagulation time were charted during a 17-day observation period in which 25% of the birds died. Thrombocytopenia and agranulocytosis developed quickly. Although the character of the blood clot changed markedly, there was no significant increase in the coagulation time as reported for animals (Allen and Jacobson, Science 105, p. 388, 1947), and the hemorrhage was much less severe than in animals. There was no increase in the number of mast cells such as occurs in people injured by atomic bomb radiation. The chicken appears relatively resistant to radiation when compared with mammals studied (Warren and Whipple, Journal of Experimental Medicine 38, p. 741, 1923).

1697 What Every Medical Officer Should Know About the Atomic Bomb. Part VII. Detection of Overexposure to Ionizing Radiation. Bulletin of the U. S. Army Medical Department 8, p. 428-431, June 1948.

The effects of overexposure may be acute or chronic. The exposures may result from any type of radiation applied externally or internally. The clinical picture will depend on the amount, rate of delivery and depth of the dose. The signs and symptoms such as thermal burns, diarrhea, nausea, vomiting, headache, anuria, purpura, blood changes, fingernail brittleness, pigmentation, etc., are discussed. A procedure to be followed in studying a person suspected of being overexposed is given.

RADIOACTIVITY

1698 A 180° Beta-Ray Spectrometer and the Beta-Ray Spectra of C^{14}, Pa^{233}, and Ir^{192}, by Paul W. Levy. AECD-2346 (CP-3702), June 30, 1945, decl. October 14, 1948. 28p. For publication in NNES and in a technical journal. (See also MDDC-975 and 1043)

A 180° spectrograph employing photographic film and a 180° spectrometer using Geiger-Müller tubes as the detecting devices are briefly described. Included are descriptions of the magnet used with these spectrometers and some of the techniques employed in making sources. The beta-ray and conversion electron spectra of C^{14}, Pa^{233}, and Ir^{192} have been determined with these instruments. The end point of the C^{14} spectrum is 0.154 Mev and no conversion lines were detected. Nine conversion lines were detected in the spectrum of Pa^{233}. One of these obliterates the end point of the continuous spectrum which is approximately 0.2 Mev. These lines can be attributed to four gamma rays of 0.084, 0.298, 0.309, and 0.337 Mev. The end point of the Ir^{192} spectrum is 0.67 Mev. This value may be in error due to the twenty-seven conversion lines attributed to twelve gamma rays superimposed on the spectrum. Included are diagrams of apparatus and graphs of results.

RADIOACTIVITY (Continued)

1699 Screening and Relativistic Effects on Beta Spectra, by C. Longmire and H. Brown. AECD-2347 (CUD-10; DR-1069), September 13, 1948, decl. October 8, 1948. 26 p. For publication in Physical Review; for oral presentation at a meeting of the American Physical Society at Chicago, November 26-27, 1948.

In interpreting data on beta-ray spectra, apparent deviations from the Fermi allowed form may be caused by neglect of the effect of screening by atomic electrons and by use of the non-relativistic approximation to the Coulomb factor. The effect of the screening on the Coulomb factor has been calculated approximately for arbitrary Z, using a method based on the Thomas-Fermi screened potential. The effect of screening is found to be an increase in the number of both positrons and electrons at low energies. Numerical results are given for S^{35}, Cu^{64}, and RaE (Bi^{210}). By use of a better approximation to the relativistic Coulomb correction factor, the error incurred by using the non-relativistic form is estimated for various emitters. It is found that for sufficiently thin sources of Cu^{64}, the neglect of the screening and relativistic effects contributes a considerable fraction of the apparent deviation from the Fermi theory.

1700 Annual Report on Contract N6ori-44, Task Order 5, Code NR-025-002. Yale University Sloane Physics Laboratory (Office of Naval Research Contract). August 15, 1948. 22p. (NP-432)

Work has been directed along four related lines, all bearing on the study of nuclear energy levels in the medium-light atomic weight region. The direct method is the observation of proton groups produced under deuteron and alpha particle bombardment. This has been applied to the following reactions: $O^{16}(d,p)O^{17}$; $Mg^{24}(d,p)Mg^{25}$; $Al^{27}(d,p)Al^{28}$; $Si^{28}(d,p)Si^{29}$; $Si^{29}(d,p)Si^{30}$; $Si^{30}(d,p)Si^{31}$; $S^{32}(d,p)S^{35}$; $S^{33}(d,p)S^{34}$; $S^{34}(d,p)S^{35}$; $A^{36}(d,p)A^{37}$; $A^{40}(d,p)A^{41}$; $Na^{23}(\alpha,p)Mg^{26}$. A second method is the study of neutron groups; this has been applied to $Al^{27}(d,n)Si^{28}$. A third method is the observation of gamma radiation in reactions occurring under bombardment. This has been applied to the following targets: O^{16}, Na^{23}, $Mg^{24,25,26}$, Al^{27}, $Si^{28,29,30}$, P^{31}, S^{32}, using both alpha particles and deuterons. The fourth approach is the observation of precise coincidences between particles and radiation; this has been applied to sulfur as a target.

In order to pursue these studies, instrumentation as follows has been developed: high resolution coincidence equipment able to measure the time of flight of the deuteron beam over a path of a meter in length; medium resolution coincidence circuits for general purposes; a naphthalene photomultiplier counter; high speed proportional counters and a magnetic analyzer for the beam; and radiation detection with photographic emulsions.

1701 The Beta-Ray Spectra of Europium and Tungsten, by Franklin B. Shull. Physical Review 74, p. 917-925, October 15, 1948.

The results of a spectrometric investigation of beta- and gamma-radiations from Eu^{152}, Eu^{154}, and W^{185} are described. The design and operation of the magnetic double-focusing beta-ray spectrometer with which the investigation was carried out are discussed. The spectra obtained for europium and tungsten are used to illustrate the performance of the instrument. Numerous curves are shown giving the various spectra and the Fermi plots for tungsten and europium. Tabulated data are given of beta spectra upper energy end points, internal conversion lines, and photoelectron lines for Eu^{152} and Eu^{154}.

1702 γ-Radiation from Be^8, by S. Devons and M. G. N. Hine. Physical Review 74, p. 976-978, October 15, 1948. (Letter to the editor)

The gamma radiation resulting from bombardment of a lithium target with protons having energies of 300-800 Kev was investigated, with special reference to angular distribution. The capture of a proton by a Li^7 nucleus results in the formation of a Be^8 nucleus having an excitation energy of 17 Mev. Previous experimental and theoretical work on the reaction is cited. The principal experimental results obtained by the authors were: (1) With a "thick" Li target and protons of 500-Kev

RADIOACTIVITY (Continued)

energy, the γ-radiation is not exactly isotropic but is of the form: $1 + 0.05 \cos \theta$. (θ is the angle between proton beam and direction of γ-radiation. Allowance is made for center of gravity motion.) (2) With a "thin" target and varying proton energy the angular distribution near resonance is of the form $1 + \alpha \cos \theta$, where α is positive for proton energies greater than about 435 Kev and negative for smaller proton energies. (3) The forward-backward asymmetry is a maximum ($|\alpha| \sim 0.3$) for proton energies of about 350 Kev and 620 Kev. A curve showing the variation of asymmetry with proton energy is shown. A distortion in the region of the resonance energy is attributed to the finite target thickness. The experimental results are consistent with the interpretation of the radiation as a superposition of electric-dipole radiation (from the 439-Kev level) and electric-quadrupole radiation (from the broad level). The angular distribution curve is discussed in detail. Results which are consistent with a short lifetime (less than 10^{-14} sec) for the compound Be^8 nucleus are mentioned.

1703 Long-Lived Metastable State of Te^{125}, by G. Friedlander, M. Goldhaber, and G. Scharff-Goldhaber. Physical Review 74, p.981-982, October 15, 1948. (Letter to the Editor)

An investigation has been made to determine whether the Te K x-rays emitted during the decay of Sb^{125} are given off by a metastable state of Te^{125}. A chemical separation of Te from Sb^{125} produced by the bombardment of Sn with slow neutrons was made. The Te fraction was found to be active and aluminum absorption measurements made. The curve for the absorption of Te^{125*} internal conversion electrons in Al is shown. Absorption measurements of the remaining photon component were made in Cd and In. The results indicate that the radiation is largely K-radiation from Te, and the half-life of Te^{125*} has been roughly determined as about two months. Similar data have been taken using Te^{125*} obtained from an aged I^{125} sample. From these experiments it is concluded that Te^{125*} decays by an isomeric transition which is probably "2^5-pole". The suitability of this nucleus for a test of the theory of nuclear isomerism by a direct measurement of the spins of the two isomers is discussed. Favorable factors for this study are: 1) this is by far the longest-lived metastable state known for a nucleus with a stable ground state, 2) weighable amounts of Te^{125*} can be obtained carrier-free. Such measurements are now in progress.

1704 Measurement of Radioactive Isotopes, by Leon F. Curtiss. Washington, Government Printing Office, 1948. National Bureau of Standards Circular 473. 12 p.

This manual is intended to accompany radioactive standards and calibrated samples of radioisotopes. It contains a discussion of the principles of measurement of radioisotopes in absolute terms with explanation of units and illustrative examples of precautions that must be taken in measurements to determine disintegration rates. A simple chart for computation of radioactive decay is included.

1705 Radioactive Br Isotopes, by L. L. Woodward, D. A. McCown, and M. L. Pool. Physical Review 74, p. 870-875, October 15, 1948.

Two new isotopes having half-lives of 1.7 hours and 2.4 days, which have been identified as Br^{75} and Br^{77} respectively, have been produced by cyclotron bombardments of electromagnetically enriched selenium. In addition, investigations on the 4.4-hour Br^{80} isotope have been made. Decay curves for the various activities and data on aluminum absorption measurements are given. The radioactive isotope Br^{77} was produced in bromine by deuteron bombardment of electromagnetically enriched Se^{76}, and by alpha-particle bombardment of electromagnetically enriched Se^{74}. A positron end point of 0.4 Mev was determined. In addition to annihilation radiation, gamma rays and K-capture were observed. The ratio of K-capture to positron emission is determined to be 20. The cross-section ratio of the (d,n) to the (d,2n) reaction producing the isotope is 0.3. The ratio of the sum of the cross sections for formation of Br^{77} by Se^{76} (d,n) and Se^{77} (d,2n) to the cross section for Br^{82} by Se^{82} (d,n) is 0.4. The radioactive isotope Br^{75} was produced in bromine by deuteron bombardment and by proton bombardment of enriched Se^{74}. A positron end point of 1.6 Mev was determined. K-capture was observed in the activity, but no gamma-ray activity other than that due to annihilation

RADIOACTIVITY (Continued)

was found. The ratio of K-capture to positron emission from the Se^{74} (d,n) reaction was determined to be 4.4. The ratio of the cross section for formation of Br^{75} by Se^{74} (d,n) to that of Br^{82} by Se^{82} (d,2n) was 2.1. The 4.4-hour Be^{80} isotope has been produced by a Se (α,p) reaction and found to emit positrons with an endpoint of 0.8 Mev. In producing Br^{77} by proton bombardment of Se the (p,γ) reaction is observed to be two-thirds as probable as the (p,n) reaction.

1706 A Study of the Radiations from Columbium (95), Rhenium (188), Osmium (191), and Osmium (193), by C. E. Mandeville, M. V. Scherb, and W. B. Keighton. Physical Review 74, p. 888-893, October 15, 1948.

The characteristic radiations of Cb^{95}, Re^{188}, Os^{191}, and Os^{193} have been investigated by coincidence and absorption methods (Physical Review 73, p. 141, 1948). Maximum beta-ray energies were determined by aluminum absorption to be 0.14, 0.225, 1.15 and 0.15 Mev, respectively. Maximum quantum energies were measured by coincidence absorption of the secondary electrons in aluminum and were found to be 0.92, 1.39, and 1.58 Mev for Cb^{95}, Re^{188}, and Os^{191}, respectively. When possible, coincidence rates for beta-beta emission, beta-gamma emission, and gamma-gamma emission were measured. It is noted that the 0.92 Mev gamma ray of Cb^{95} has previously been erroneously attributed to Zr^{95} by the authors (Physical Review 73, p. 1434, 1948). Coincidence data on Cb^{95} indicate beta emission is followed by emission of 0.92 Mev gamma rays or by an alternate mode involving the emission of two or more gamma rays. Some of the gamma rays are converted in Cb^{95} as evidenced by a small number of beta-beta coincidences. From coincidence data on Re^{188} a tentative disintegration scheme has been diagrammed. For both Os^{191} and Re^{188} it is suggested that the hard beta rays emitted result in a low-lying excited state of the residual nucleus. The data on coincidence rates and absorption in aluminum for these elements is given in 13 curves. In addition some work on Sb^{124} has indicated the presence of beta-beta coincidences confirming previous reports of internal conversion (Kern, Zaffarano, and Mitchell, Physical Review 73, p. 1142, 1948). Details of the chemical purification of Au^{198} and of Cb^{95} are given.

RADIOCHEMISTRY

1707 Oxidation of Ferrous Ions in Aqueous Solution by X- and γ-Radiation, by N. Miller. Nature 162, p. 448-449, September 18, 1948.

It has been confirmed that the rate of oxidation of ferrous ions by X- and γ-radiation is essentially independent of ferrous ion concentration in the region 10^{-3} to 10^{-4} M, and that this rate is maintained independently of the radiation wave-length over a wide range of wave-lengths. Expressed as the number of atoms of ferrous ion oxidized per 32.5 ev expended in the solution, the average value for ionic yields for solutions containing dissolved oxygen is 5.5. The results agree with those of Fricke (American Journal of Roentgenology and Radium Therapy 18, p. 430, 1927; Physical Review 31, p. 1117, 1928; Philosophical Magazine 7, p. 129, 1929; Journal of Chemical Physics 3, p. 60, 1935) and Shishacow (Philosophical Magazine 14, p. 198, 1932). The results show that ionic yields higher than 2.2 observed in solutions that are not de-aerated are due to dissolved oxygen.

RADIOTHERAPY

1708 Irradiation of Pituitary Tumors. Results in Fifty Cases, by H. Dabney Kerr. American Journal of Roentgenology and Radium Therapy 60, p. 348-359, September 1948.

This review of a series of 50 cases of pituitary tumors emphasizes the fact that irradiation by x-rays is a satisfactory primary method of treatment. There are over-all good results in the range of 70% and the chromophobic tumors respond as well as the acidophilic. Cures appeared to be permanent in 24 of the cases six years after treatment. It appears questionable whether psychotic patients or patients with any previous cerebral symptoms should be irradiated for their symtoms may

RADIOTHERAPY (Continued)

be exaggerated. Although there may possibly be occasional cerebral damage from irradiation, there is no proof of it. Data are presented in α four-page table. 21 references.

1709 Radon Treatment of Cancer of the Cervix Uteri. A Detailed Report of 137 Cases, by Frank E. Simpson and J. Ernest Breed. American Journal of Roentgenology and Radium Therapy 60, p. 382-386, September 1948.

One hundred and thirty-seven women, aged 26 to 85, were treated with radon for 20 to 30 minutes daily or on alternate days until 3,000 to 6,000 millicurie-hours had been given. A study of those cases given inadequate external irradiation shows a five-year recovery rate of 45.8%, while the five-year recovery rate of the entire group was 43.7%. This would appear to indicate that irradiation from the skin surface is of secondary importance in the early cases. 6 references, 2 tables, and 3 graphs.

1710 The Use of Radon Seeds (Tubules) in the Treatment of Benign and Malignant Conditions, by Ira I. Kaplan. Medical Record 161, p. 507-509, October 1948.

Radon seed therapy is a rational method of applying irradiation to neoplasms throughout the body, especially to lesions in not readily accessible areas. Various technics for inserting radon seeds may be used and easily modified by requirements of the condition to be treated. The dosage can be accurately gaged. The residual metallic containers of radon have in no instances created any hazard when left remaining in the tissue. Loss of the seeds is of slight moment due to their insignificant value and their radioactivity is completely vitiated in thirty days.

RARE EARTHS

1711 Absorption and Fluorescence Spectra of Bivalent Samarium, Europium and Ytterbium, by F. D. S. Butement. Transactions of the Faraday Society 44, p. 617-626, September 1948.

Using a Hilger medium spectrograph, absorption and fluorescence spectra were taken of aqueous solution of samarous, europous, and ytterbous chloride, and some solids containing the bivalent ions. The absorption probabilities for the bands were calculated. For all three ions, diffuse bands due to 4f→5d or 6s transitions are noted. Sm^{++} and Eu^{++} have narrow, weak bands, which can be correlated with those of the isoelectronic Eu^{++} and Gd^{++}, respectively. Spectra and tables of the band frequencies are given.

1712 Crystal Structures of a Series of Rare Earth Phosphates, by Rose C. L. Mooney. Journal of Chemical Physics 16, p. 1003, October 1948. (Letter to the editor)

Using x-ray diffraction techniques, the crystal structures of the phosphates of trivalent lanthanum, cerium, praseodymium, and neodymium were determined. The crystals were found to be dimorphic, one phase being monoclinic, isomorphous with monazite. The other phase is a hexagonal structure of a new type, which converts to monoclinic form at moderately high temperatures. Tables of cell constants, densities, and structural parameters are given. A more detailed account is to be published later.

1713 The Fractionation of Cerium (III) and Neodymium Mixtures on an Ion-Exchange Column, by B. A. Lister and M. L. Smith. Journal of the Chemical Society 1948, p. 1272-1275, August 1948.

A method of preferential ionic exchange was used in examining the possibility of separating simple mixtures of cerium and neodymium salts. The exchanger was "Zeokarb H.I.P.," a sulfonated coal. It was used in a novel multitube column. It was seen that the exchange characteristics of Ce^{+++}, Pr^{+++}, and Nd^{+++} were the same within the limits of experimental sensitivity. Two different ion concentrations were used (1M and $\frac{1}{4}$ M), the reduced concentration increasing the separation. It is suggested that this may be due to a difference in the relative degree of hydration of the two ions at

RARE EARTHS (Continued)

different concentrations. It was noted that the cerium was more strongly held, which is contrary to data by Russell and Pearce (Journal of the American Chemical Society 65, p. 595, 1943). A line diagram of the multitube column apparatus and a curve of separation factor versus cumulative concentration in the percolate are given.

1714 Mass Disposition of Completely Resolved Samarium Isotopes, by A. E. Shaw. Physical Review 74, p. 980 - 981, October 15, 1948. (See also AECD-2210)

This letter is based upon AECD-2210 which has been listed in Nuclear Science Abstracts as abstract No. I-1041.

1715 Neutron Deficient Isotopes of Cerium and Lanthanum, by J. B. Chubbuck and I. Perlman. Physical Review 74, p. 982-983, October 15, 1948. (See also AECD-2218)

This letter to the editor is based upon AECD-2218 which has been listed in Nuclear Science Abstracts as Abstract No. I-1042.

1716 The Rare Earth Metals and their Compounds. Part VIII. An Improved Method for the Synthesis of Some Rare Earth Acetylacetonates, by Joseph G. Stites, C. N. McCarty, and Laurence L. Quill. Journal of the American Chemical Society 70, p. 3142-3143, September 1948.

The effect of changing the acidity on the formation of the rare earth acetylacetonates was studied. Salts of La, Ce, Pr, Nd, Sm, Eu, Y were prepared, and the yields are listed in tabular form. The yield is seen to be a function of the pH of the solution and a typical pH versus yield curve is given.

SCIENTIFIC RESEARCH

1717 Atomic-Energy Program. Mechanical Engineering 70, p. 820-822, October 1948.

The recent progress of the atomic energy program is briefly reviewed. Atomic power, particle accelerators, and availability of isotopes are discussed.

1718 Radioactive Isotopes for Clinical Research, by Medical Research Council. Lancet 255, p. 469-470, September 18, 1948; British Medical Journal September 18, 1948, p. 569.

The Medical Research Council (Great Britain) announces that it has made arrangements to obtain limited quantities of certain radioactive isotopes for medical research from the United States Atomic Energy Commission. The type of information to be supplied in applying for and the conditions to be met in obtaining the isotopes are explained, along with a warning of the dangers involved in their use.

SPECTROSCOPY

1719 The Spectrochemical Determination of Hafnium-Zirconium Ratios, by C. Feldman. AECD-2342, n.d., decl. October 14, 1948. 19p. For publication in NNES; for submission to Journal of the Optical Society of America; for presentation at a meeting of the Optical Society of America in Detroit, Michigan, October 21-22, 1948.

An abstract of this document was assigned the number AECD-2285. The abstract has been listed in Nuclear Science Abstracts as Abstract No. I-1208.

SPECTROSCOPY (Continued)

1720 The Hyperfine Structure of Tritium, by E. B. Nelson and J. E. Nafe. AECD-2350 (CUD-11; DR-1072), September 15, 1948, decl. October 8, 1948. 1p. For publication in Bulletin of the American Physical Society; informal disposition.

This document is an abstract; it is reproduced below in its entirety.

The h.f.s. of the ground state of tritium was measured by the atomic beam magnetic-resonance method. The apparatus previously used in the measurement of the h.f.s. of H and D was modified to permit the recirculation of a small sample of tritium. The frequency of the field independent, central Zeeman component of the transition $F = 1 \rightleftarrows F = 0$ gives the h.f.s. almost exactly with a field correction of less than 0.001 Mc. The mean of three independent determinations of the h.f.s. in different weak magnetic fields is 1516.702 + 0.010 Mc. The probable error is caused by the uncertainty in the Doppler correction and possible asymmetry in the resonance line causing a shift of the center of the line. The reproducibility of determining the center of the resonance line was ± 0.002 Mc. The theoretical value of the h.f.s. based on the triton-proton moment ratio (F. Block, A. E. Graves, M. Packard, and R. W. Spence, Physical Review 71, p. 551, 1947) and the value of the h.f.s. (J. E. Nafe and E. B. Nelson, Physical Review 73, p. 718, 1948) of H is 1516.709 ± 0.915 Mc. The theoretical and experimental values agree within the probable error in the ratio of the moments, 1 part in 10^5. This close agreement is in accord with the calculations of Teller (Pocono Conference, sponsored by the National Academy of Science, April 1, 1948), who has considered the detailed interaction of the electron with the elementary particles of the triton.

1721 A New Measurement of the Packing Fractions of the Nickel Isotopes, by A. E. Shaw. AECD-2351 (ANL-AJD-256), September 20, 1948, decl. October 7, 1948. 6p. For publication in Physical Review.

The packing fractions of the nickel isotopes have been measured using a new source of nickel ions. A tungsten crucible containing nickel metal was supported in the axis of a pure tungsten filament. Electrons from the filament vaporized the material in the crucible and ionized it as it emerged through a hole in the cap. Results of the measurements of Ni^{58}, Ni^{60}, Ni^{61}, Ni^{62} and Ni^{64} are summarized in a table.

1722 An Automatic Recording Spectrophotometer, by Thomas Coor and D. C. Smith. Naval Research Laboratory (Chemistry Division-Chemical Spectroscopy Section) Report No. P-2846, May 28, 1948. 38p. (NP-272)

It was the purpose of this investigation to design and construct an ultraviolet spectrophotometer which would operate automatically, record per cent transmission as a function of wavelength, and have optical characteristics (resolution and accuracy) equivalent or superior to those of the Beckman spectrophotometer. It was desired to do this, by modifying a Beckman instrument which was already available. An instrument utilizing the monochromator of a Beckman Quartz spectrophotometer and a Brown "Electronik" recorder has been developed for automatic recording of percent transmission from 2000 to 4000 Angstroms. An increase in resolution has been obtained without appreciable sacrifice in accuracy of transmission measurement and a complete spectrum is automatically recorded in less than fifteen minutes.

1723 Infrared Spectra of Some Natural Elastomers, by R. A. Saunders and D. C. Smith. Naval Research Laboratory Report No. C-3285, May 17, 1948. 22p.

Samples of hevea, guayule, kok-saghyz, gutta-percha, balata and chicle were investigated over the 2 - 15 mu region. For each sample the spectra of the pure hydrocarbon component and of the impurity fraction were obtained at room temperature. Purified samples were also examined over the temperature range -25°C to +80°C and marked spectral differences were observed for different phases of the solid state. The spectra of a number of reference compounds are given and correlations of spectral absorption with molecular structure are discussed.

SPECTROSCOPY (Continued)

1724 Progress Report of A Study of Standard Methods for Spectrographic Analysis, by G. H. Dieke. National Research Council War Metallurgy Committee (Johns Hopkins University) Serial No. W.54, September 24, 1943. 33p. (NP-421)

The fundamentals of spectroscopy are discussed, and the necessity for calibrating the photographic plates used in spectrographic methods indicated. The following calibrating techniques are briefly reviewed: rotating step sector, inverse square law, intensity relations in the iron spectrum, and varying exposure time. The applicability and detailed specific instructions for a calibrating technique using homogeneous iron lines is given. This technique makes use of the fact that in the spectrum of every element there are groups of lines called homogeneous lines, the relative intensity of which are independent of light source conditions.

1725 Atomic Energy Levels as Derived from the Analyses of Optical Spectra. Vol. 1, Section 1: The Spectra of Hydrogen, Deuterium, Helium, Lithium, Beryllium, Boron, Carbon, Nitrogen, Oxygen and Fluorine, by Charlotte E. Moore. National Bureau of Standards Circular 467, April 15, 1948. 75p.

This is the first of a series of reports which will probably eventually replace Bacher and Goudsmit's "Atomic Energy States." The spectra of the elements of the first row of the periodic table are listed with the ground-state of the atom taken as zero energy. The recent work of Edlen, including previously unpublished results, appears in the report.

1726 A Direct Reading Analytical Spectroscope, by Frederick K. Vreeland. The American Mineralogist 33, p. 600-611, September-October 1948.

A system of spectroscopic analysis for qualitative determination and semi-quantitative estimation of elements present in a sample has been developed. The method avoids wave-length measurements and reference tables by direct comparison of the sample spectrum with master spectra of several elements. Progressive excitation of the elements by progressive heating also facilitates the use of the method. Elimination films and identification films of the elements are used to see if the element is present as a major constituent, a minor constituent, in a small percentage, or as a trace. The system is especially adaptable for detection of titanium in irons, hafnium in zircon, cesium, rubidium and thallium in lepidolite, and for such problems as the relation of impurities to color and fluorescence. Photographs are given of the apparatus, identification films, elimination films, and spectra of iron minerals matched against master films.

1727 Focusing Field for a 180° Type Spectrograph, by F. M. Beiduk and E. J. Konopinski. Review of Scientific Instruments 19, p. 594-598, September 1948.

A magnetic field is derived for a 180° type of spectrograph so as to meet two requirements: it is to vary only with the distance from the central axis; it must focus perfectly the electrons emerging from a point source and confined in the median plane. The transmission and resolution of an instrument using such a field are then investigated.

1728 A Grating Spectrometer for Millimeter Waves, by Robert J. Coates. Review of Scientific Instruments 19, p. 586-590, September 1948.

A spectrometer based upon a reflecting echelette type grating was designed for the wavelength range from 3 to 12.5 millimeters since the millimeter wave-length region appears to be the crossover region beyond which optical measuring techniques are preferable to microwave techniques. The operation of the spectrometer is completely automatic, and the curve of received signal intensity vs. grating angle for all orders (including the zero order) is registered by a recording output meter. From the record, the grating angles corresponding to the intensity peaks at the different orders can be read within ± 1 minute of arc, giving an accuracy of about ± 0.04 percent for measurements of the wave-lengths of millimeter monochromatic sources. The factors that influenced the design of the components of the spectrometer are presented. The illumination of the grating by the antenna system

SPECTROSCOPY (Continued)

is incorporated in the derivation of the theoretical equation for the grating intensity curve. It is shown that this theoretical curve agrees closely with the actual spectrometer records. Photographs and a block diagram of the apparatus are shown.

1729 A Microwave Secondary Frequency Standard, by Robert R. Unterberger and William V. Smith. Review of Scientific Instruments 19, p. 580-585, September 1948.

A method of obtaining accurate frequency markers every 90 megacycles from 2970 megacycles to above 40,000 megacycles is described. Interpolation between markers is possible by means of a calibrated standard communications receiver. The basic frequency of 10 megacycles is continuously checked against the primary frequency standard broadcast by WWV. This equipment may be used for measuring the frequencies of spectra observed in microwave spectroscopy or for accurately calibrating microwave wavemeters. A table of ammonia absorption lines providing reference frequencies between 23,000 and 40,000 megacycles is given.

1730 A Rapid Method of Spectrographic Analysis, by H. R. Clayton. Journal of the Society of Chemical Industry 67, p. 270-273, July 1948.

By using ultra rapid photographic reagents and by drying plates in special stoves, a process has been developed which enables spectrographic analyses to be carried out in approximately ten minutes. The error diminishes with prolonged time. Thus a $\pm 4\%$ error results from an 8½ minute process, whereas in 9½ minutes, a $\pm 3\%$ error results. Tables are given comparing different films, showing the effects of the exposure time and speed of processing, and indicating the proper method to be used.

1731 Spectrum of Helium-3, by L. C. Bradley and H. Kuhn. Nature 162, p. 412-413, September 11, 1948. (Letter to the editors)

It was possible to detect satellites of helium-3 in a concentration of 1:700 by using two étalons of equal spacing in series. The satellite of an enriched sample of helium-3, with a concentration of 1:70, was photographed and measured with a single étalon. The helium-3 line had a separation of -0.83 ± 0.03 cm^{-1} from the helium-4 line. Using the theory of Hughes and Eckart, Physical Review 36, p. 694, 1930; Physical Review 36, p. 878, 1930) an isotope shift of the line 2^1S-3^1P of -0.77 cm^{-1}, outside the limits of error of the experimental value, is given. The two spectrograms of helium-3 (1:70 and 1:700) are shown.

1732 Structure of the ^2D Terms of the Arc Spectrum of Lithium, by K. W. Meissner, L. G. Mundie, and F. H. Stelson. Physical Review 74, p. 932-938, October 15, 1948.

Interferrometric wave-length measurements of high precision carried out by employing an atomic beam light source have been used for the study of several features of the arc spectrum of Li^7. Because of the great sharpness of the spectral lines produced by this source it was possible to determine the splitting of several ^2D terms. The hyperfine structure of the line 6708A was found in approximate agreement with earlier investigations. Precise wave-length measurements have been carried out relative to krypton standards. Discrepancies between the wave-lengths of this investigation and those of earlier investigators must be ascribed to lack of resolution or inadequate comparison methods employed in earlier investigations. This consideration is substantiated by measurements carried out with a vacuum lithium arc, the results of which are consistent with the atomic beam values. Isotopic shift (Li^6 and Li^7) of the resonance line 6708A was measured. A table is given of the wave-lengths obtained with an atomic beam source, and tabulated wave-lengths obtained using a vacuum arc are compared with those obtained using other sources.

TRACER APPLICATIONS, RADIOACTIVE

1733 The In-Vitro Incorporation of the Methylene Carbon Atom of Glycine into Rabbit Bone Marrow Fats, by Kurt I. Altman. AECD-2361, September 29, 1948, decl. October 27, 1948. 5p. For publication in Journal of Biological Chemistry.

When rabbit bone marrow homogenates were incubated with glycine labeled with C^{14} in the α-carbon atom, it was observed that the saturated and unsaturated fatty acids isolated from the lipid fraction of these homogenates contained appreciable C^{14}-activity. These findings are considered of interest in that they might throw light upon the metabolism of bone marrow fats. The data indicate that the methylene carbon atom of glycine is incorporated in the saturated fatty acids of bone marrow and that the isotope concentrations in the saturated fatty acids are considerably higher than in the unsaturated fatty acids. Since it has been established that acetate serves as a source of carbon for fatty acid synthesis and since it has been shown that acetate metabolism plays a highly important role in the bone marrow, these experiments suggest that rabbit bone marrow might be capable of effecting the conversion of glycine to acetate.

1734 Absorption and Excretion Studies with Radioactive Penicillin, by S. Rowlands, D. Rowley, and H. C. Stewart. Lancet 255, p. 493-495, September 25, 1948.

Urinary excretion studies were carried out in female cats using penicillin labelled with S^{35}. Intramuscular injections of ordinary and labelled penicillin gave rise to a urinary excretion of 100% of the radioactive sulphur isotope, but to a much smaller recovery of penicillin. There was no evidence of retention of penicillin in the body as the radioactive breakdown products were excreted over the same time interval as the penicillin. When the labelled penicillin was given by mouth much less was excreted; the amount of radioactivity remaining in the gut at the end of the experiment suggested that non-absorption would account for the penicillin not found in the urine. A brief review on the use of radioactive penicillin with an annotation concerning this paper also appears on pages 501-502 of this same issue of Lancet.

1735 The Antithyroid Effect of Certain Foods in Man as Determined with Radioactive Iodine, by Monte A. Greer and E. B. Astwood. Endocrinology 43, p.105-119. August 1948.

The antithyroid effect of sixty-one different foods was tested in one hundred different subjects by using radioactive iodine. Of these, rutabaga was found to possess the greatest antithyroid activity. Vegetables were more active than animal products and the most potent vegetable families were the Chenopodiaceae, Compositae, Cruciferae, Cupuliferae, Juglandaceae, Leguminosae, Rosaceae, and Umbelliferae. Cow's milk, beef liver, and oysters also showed some activity. The active principle of rutabagas could be extracted from a watery solution with ether and was contained in the water-soluble portion of this dried ether extract. 14 references.

1736 Chemical Alteration of Polysaccharide from Serratia Marcescens. Part I. Tumor-Necrotizing Polysaccharide Tagged with Radioactive Iodine, by Arnold M. Seligman, M. J. Shear, Joseph Leiter, and Benjamin Sweet. Journal of the National Cancer Institute 9, p.13-18, August 1948.

The polysaccharide from Serratia marcescens was tagged with radioactive iodine without destruction of its tumor-necrotizing property by a procedure involving alkaline iodination. The iodination of polysaccharide with varying amounts of iodine showed saturation of the molecule over a wide range of iodine concentration. The rate of production of radioactive dialyzable material from radioiodopolysaccharide with fresh mouse liver homogenate was determined. The rate of disappearance from the blood of intravenously injected radioiodopolysaccharide was measured in pilot experiments (mouse, rabbit, and man). The distribution of radioactivity at various intervals after injection of radioiodopolysaccharide in the normal tissues and in tumor tissue of mice was measured in two experiments. 14 references.

TRACER APPLICATIONS, RADIOACTIVE (Continued)

1737 Chemical Alteration of Polysaccharide from Serratia Marcescens. Part II. Effects of Iodopolysaccharide in Patients with Malignant Tumors, by Theodore Sack and Arnold M. Seligman. Journal of the National Cancer Institute 9, p.19-34, August 1948.

Iodinated tumor-necrotizing polysaccharide in which radioactive iodine is used was given intravenously to 7 patients with metastatic cancer. The initial doses varied between 2 and 20 micrograms. The largest single dose was 3,000 micrograms. A total of 31 injections was made. The post-injection reactions consisted mainly of a rise in body temperature and a fall in arterial blood pressure. The reactions were similar to those obtained with unmodified polysaccharide. No evidence was obtained that the iodinated polysaccharide was less toxic than the unmodified material. Rapid development of tolerance with decrease in toxicity was observed following administration of iodopolysaccharide, similar to findings with the unmodified material. Cross-resistance between the two was also noted. There was no clinical or pathologic evidence that injection of iodinated polysaccharide had any destructive effect on tumor tissue in the doses given to these patients. 11 references.

1738 The Clinical Use of Sodium Fluorescein and Radioactive Diiodofluorescein in the Localization of Tumors of the Central Nervous System, by George E. Moore, William T. Peyton, Samuel W. Hunter, and Lyle French. Minnesota Medicine 31, p. 1073-1076, October 1948.

Because sodium fluorescein is so consistently taken up by tumors of the central nervous system and its use is such a simple and accurate technique in their localization and diagnosis, it seemed possible that adding radioactive isotopes to it might increase its usefulness. Accordingly, about 1 millicurie of I^{131} in the form of diiodofluorescein was injected intravenously in 26 patients suspected of having brain tumors. Two to four hours later counts were made over the head with a Geiger-Mueller counter. By this method 8 tumors were correctly localized; two tumors were located close to but not exactly at the correct site; in six no focal lesions could be located and none was demonstrated by operation; seven tumors were incorrectly localized or missed; and one tumor was localized only as to the proper hemisphere. This summary indicates that the localization of tumors by Geiger count is still uncertain and that it is not to be relied upon for operation on otherwise unlocalized tumors until further improvements have been made in apparatus and technique. 23 references.

1739 The Influence of Estrogens on Thyroid Function as Measured by Uptake of Radioactive Iodine, by K. E. Paschkis, A. Cantarow, and W. C. Peacock. Proceedings of the Society for Experimental Biology and Medicine 68, p. 485-486, July-August 1948.

The data presented indicate that neither ovariectomy nor administration of estrogenic hormone (α-estradiol benzoate) influences the uptake of tracer doses of I^{131} by the thyroid of the rat. 2 tables.

1740 Radioactive Iodine: Its Use in Studying the Urinary Excretion of Iodine by Humans in Various States of Thyroid Function, by Bengt Skanse. Acta Medica Scandinavica 131, p. 251-268, 1948.

The objectives of this study were: 1) to determine the total urinary excretion of radioactive iodine in a 48-hour period in various clinical states of thyroid function when the quantity of iodine was kept comparatively small and constant; 2) to determine the rate of urinary excretion of iodine in similar subjects; and 3) to study the possibility of using these studies as a means of diagnosing certain diseases of the thyroid. Doses of 100 microcuries were given orally to three groups of patients—thyrotoxic, euthroid, and myxedematous. The 48-hour urinary excretion for 25 patients with thyrotoxicosis varied between 6.2 and 32.3% with an average of 19.2%. That for 15 euthyroid patients (controls) ranged between 52.7 and 84.1% with an average of 66.6%. And that for 6 cases of myxedemia varied between 72.4 and 91.7%. No overlapping has been observed between the first

TRACER APPLICATIONS, RADIOACTIVE (Continued)

two groups so far. Such extra thyroidal factors as rate of absorption from gastrointestinal tract, presence of food, and iodine excretion by the kidney in health and disease are discussed. It is concluded that it is possible for this method to be used for diagnostic purposes. 23 references.

1741 Radioactive Isotopes, by F. Y. Khoo. Chinese Medical Journal 66, p. 283-289, May 1948. (editorial)

The use of radioactive isotopes as tracers in metabolism studies and as therapeutic agents is reviewed generally.

1742 Radioactive Phosphate Permeability in Dentin Following the Use of Medicaments, by Melvin H. Amler. Journal of Dental Research 27, p. 635-639, October 1948.

P^{32} penetration of the dentin was found to be highest in phenol-treated dentin, and less, in the order indicated, in phenol followed by alcohol, fluorine, silver nitrate followed by eugenol, and cavity varnish. Penetration was greater in all cases than in the control dentin. Oxyphosphate cement base proved to be completely impervious. It is concluded that, considering the effect of the commonly used medicaments on the vital protoplasm in the dentinal tubules, it might be advisable to discard their use in favor of less caustic medicaments. 19 references.

URANIUM

1743 A Preliminary Investigation of the Spectra of Uranium Isotopes, by J. R. McNally, Jr. AECD-2349 (Y-232), September 9, 1948, decl. October 15, 1948. 14p. For oral presentation to Optical Society of America in Detroit, October 21-22, 1948; for publication in a scientific journal.

An abstract of this document was assigned the number AECD-2302. The abstract was listed in Nuclear Science Abstracts as Abstract No. I-1361.

1744 Preparation of Uranium Trichloride by Reduction of the Tetrachloride with Metals by H. S. Young. AECD-2360, February 1947, decl. October 22, 1948. 2p. For publication in NNES.

This is not an abstract; the document is reproduced below in its entirety.

INTRODUCTION. When metallic copper was exposed to vapors of uranium tetrachloride, it was found that uranium trichloride and copper chloride were formed. The formation of uranium trichloride from copper and the tetrachloride suggested that it might be convenient to prepare pure uranium trichloride in a similar fashion, using a metal that would leave no contaminants in the product.

DISCUSSION. Various metals were exposed to pure uranium tetrachloride vapors in a vacuum sublimation apparatus. In each case the overall reaction was found to be $x\ UCl_4 + M \rightarrow x\ UCl_3 + MCl_x$. A difficulty was presented by the fact that with many metals the uranium trichloride formed a hard coat of dark red crystals on the metal surface, preventing further reaction, and was contaminated by the chloride of the metal. It was thought that a metal which sublimed readily and which had a volatile chloride should be satisfactory. Zinc metal satisfies these conditions and large yields of pure uranium trichlorides were obtained by its use.

EXPERIMENTAL. The apparatus was essentially an all glass vacuum sublimation still with a controlled temperature gradient maintained in the condenser, so that vapors were fractionally condensed. The metals were placed at a position adjacent to the charge of uranium tetrachloride. The tetrachloride vapors passed over the hot metal at 450-480°C. The excess tetrachloride vapors as well as the volatile reaction products were fractionally condensed for identification, and the yield of uranium trichloride and weight loss of metal were determined.

Sixty-two grams of zinc metal and ninety-seven grams of uranium tetrachloride were charged in a typical experiment. After eighteen hours all the zinc and thirteen grams of the uranium tetrachloride had sublimed from the charge section. The quantity of uranium trichloride produced, 10.2 grams, represents 86% conversion of the tetrachloride vapors. This uranium

URANIUM (Continued)

trichloride analyzed 69.3% U, 30.8% Cl, 0.18% Zn. Theoretical analysis is 69.1% U, 30.9% Cl.

SUMMARY. Good quality uranium trichloride can be prepared by reduction of uranium tetrachloride vapors by metallic zinc. Zinc and its chloride sublime readily, continually exposing new surface for reaction, and zinc chloride is so volatile that it does not appreciably contaminate the uranium trichloride produced.

REFERENCES. Young, H. S., Wagner, E. L., and Miller, A. J., CEW-TEC Report C-2.350.5, Nov. 23, 1945.

1745 Chemical and Physical Properties of Uranium Peroxide, by L. J. Brady, C. D. Susano, and C. E. Larson. AECD-2366 (Y-169), May 21, 1948, decl. November 1, 1948. 12p. For oral presentation at the April 1948 symposium of the American Chemical Society. Document for sale by AEC.

An abstract of this document was assigned the number AECD-1741 (ANL-JJK-14B-112). This abstract, listing C. E. Larson only as author, appeared in Abstracts of Declassified Documents 2, p. 174-175, March 31, 1948.

VACUUM

1746 5-micron Pressures Obtained, Held by Vacuum Pump. Chemical Processing Preview 11, No. 10 p. 98-99, October 1948.

A new type of vacuum pump, automatically lubricated, requiring minimum floor space, and having a high volumetric efficiency, is now available in 6 sizes. It has a new exhaust valve assembly, will obtain and hold a high vacuum of 5 microns, and is available at F. J. Stokes Machine Co., Philadelphia.

1747 The Glycerol Vapour Vacuum Pump, by Paul Alexander. Journal of Scientific Instruments and of Physics in Industry 25, p. 313-314, September 1948.

The glycerol vapor vacuum pump is described as a pump combining the advantages of both oil and mercury pumps. The efficiency of a vapor pump in the various pressure ranges is determined mainly by the vapor pressure of the pump liquid as a function of the temperature. Glycerol at normal temperature has a lower vapor pressure than mercury, and at higher temperatures a higher vapor pressure than most of the pump oils. Tabulated data comparing the vapor pressures of glycerol and mercury as a function of temperature are given. The efficient working range of the glycerol vapor pump is wider than that of the oil vapor pumps, and they work more efficiently than the mercury vapor pumps in the lowest pressure ranges. Curves comparing the pumping speed as a function of pressure for glycerol and mercury are given. Operating procedures and the advantages and disadvantages of using this type of vapor pump are discussed.

1748 An Ionization Manometer of High Sensitivity, by R. E. B. Makinson and P. B. Treacy. Journal of Scientific Instruments and of Physics in Industry 25, p. 298-299, September 1948.

An ionization manometer is described which has a sensitivity of 380 microamperes per micron of pressure at pressures below 0.8 microns. In this instrument the trajectories of the thermionic electrons are lengthened by means of a magnetic field. A diagram of the instrument, which consists essentially of an "inverted" magnetron with a central anode, is shown. The ion-collecting electrode is a cylinder, the anode a wire along the cylinder axis and the filament is near the collector parallel to the axis; and axial magnetic field is applied. A curve of collector current as a function of collector potential at a pressure of 3×10^{-5} mm is shown. In taking the data an anode potential of 380 volts and a field of 150 oersteds were used. The total emission was 0.64 milliamperes. The shape of the curve suggests the presence of high frequency oscillations, but no direct evidence of these could be detected. A calibration curve for dry air, obtained using the same circuit constants, which gives the collector current as a function of pressure is shown. The collector potential used was -20 volts.

X-RAYS

1749 Production, Absorption, and Scattering of High Voltage X-Rays (Volume 4, Final Report on the MIT Project in High Voltage Radiography). Cambridge, Mass., Massachusetts Institute of Technology (Office of Scientific Research and Development Contract), June 1, 1945. 116p. (NP-154)

Knowledge of the fundamental properties of X-rays and their production is of considerable value in properly designing X-ray apparatus and in devising the best radiographic technique. This volume is devoted to a study, both experimental and theoretical, of these properties and their application to radiography.

In chapter 1, the properties of the X-rays produced by high voltage electrons striking a gold target are described. These properties include the angular distribution in intensity and hardness of the X-rays. In chapter 2 the passage of X-rays through matter is considered in the case where X-rays are all of the same energy. The three physical processes responsible for the absorption (photoelectric effect, pair production, and Compton effect) are considered. Chapter 3 is concerned with the passage of X-rays through matter in the case in which the X-rays are inhomogeneous in energy. In chapter 4 the results of chapters 1, 2, and 3 are applied to radiography. Diagrams of apparatus, photographs and graphs are included. 9 references.

1750 Report on Use of Oil Diffusion Pump for X-ray Tube in 2 Million Volt Electrostatic X-Ray Machine, by B. C. Carr, Jr. Naval Mine Depot, Yorktown, Va., Research and Development Division Report No. 15, July 21, 1948. 8p. (NP-425)

The object of this report is to tell of the application of an oil diffusion pump as used in the high vacuum system for the continuously pumped X-ray tube of a 2 million volt electrostatic X-ray generator. Operating characteristics are included to indicate the improvement of this type system over a previously used mercury diffusion system. In the mercury diffusion system the mercury vapors given off from the diffusion pump caused shutdown of the X-ray machine when they reached the X-ray tube region. It was practically impossible to trap these vapors with a combination of dry ice and liquid air traps. It was believed that oil vapors could be trapped much more effectively with the same traps. Therefore an oil diffusion system was installed. It is felt that the oil diffusion pump used on the continuously-pumped tube will give good results consistently if no leaks are present. The oil used may break down after prolonged periods. Since air definitely causes the oil to break down, it is imperative that all leaks be eliminated.

1751 A "Parallel-Beam" Concentrating Monochromator for X-rays, by R. C. Evans, P. B. Hirach, and J. N. Kellar. Acta Crystallographica 1, Part 3, p. 124, July 1948.

The performance of a concentrating x-ray monochromator, proposed by Fankuchen (Nature 139, p. 193, 1937), in which the beam is monochromatized by reflection from a crystal surface inclined at an angle ϕ to the Bragg reflecting planes, has been studied experimentally by investigating the variation of intensity of the reflected beam as a function of ϕ and for $\phi = 0$. The ratio of reflected to incident intensity reaches a maximum for a certain value of ϕ; this maximum is always less than twice the ratio for $\phi = 0$. An explanation in terms of surface inhomogeneities is suggested, and the formulas derived on these assumptions are found to fit the experimental curves well. The reflected intensity varies widely with the surface treatment applied to the crystal. With calcite the reflectivity is enhanced by rubbing the surface with wood or grinding it lightly on fine sandpaper, but the use of any coarser abrasive decreases the intensity of reflection. The practical application of this kind of monochromator is discussed and a method of providing a very narrow beam of monochromatic radiation is suggested. The experimental arrangement is shown diagrammatically. Curves of the ratio of the intensities of reflected to incident beams as a function of ϕ are shown for calcite, quartz, and fluorite using Cu K_α radiation. Tabulated data on integrated reflection for various surface treatments of calcite are given.